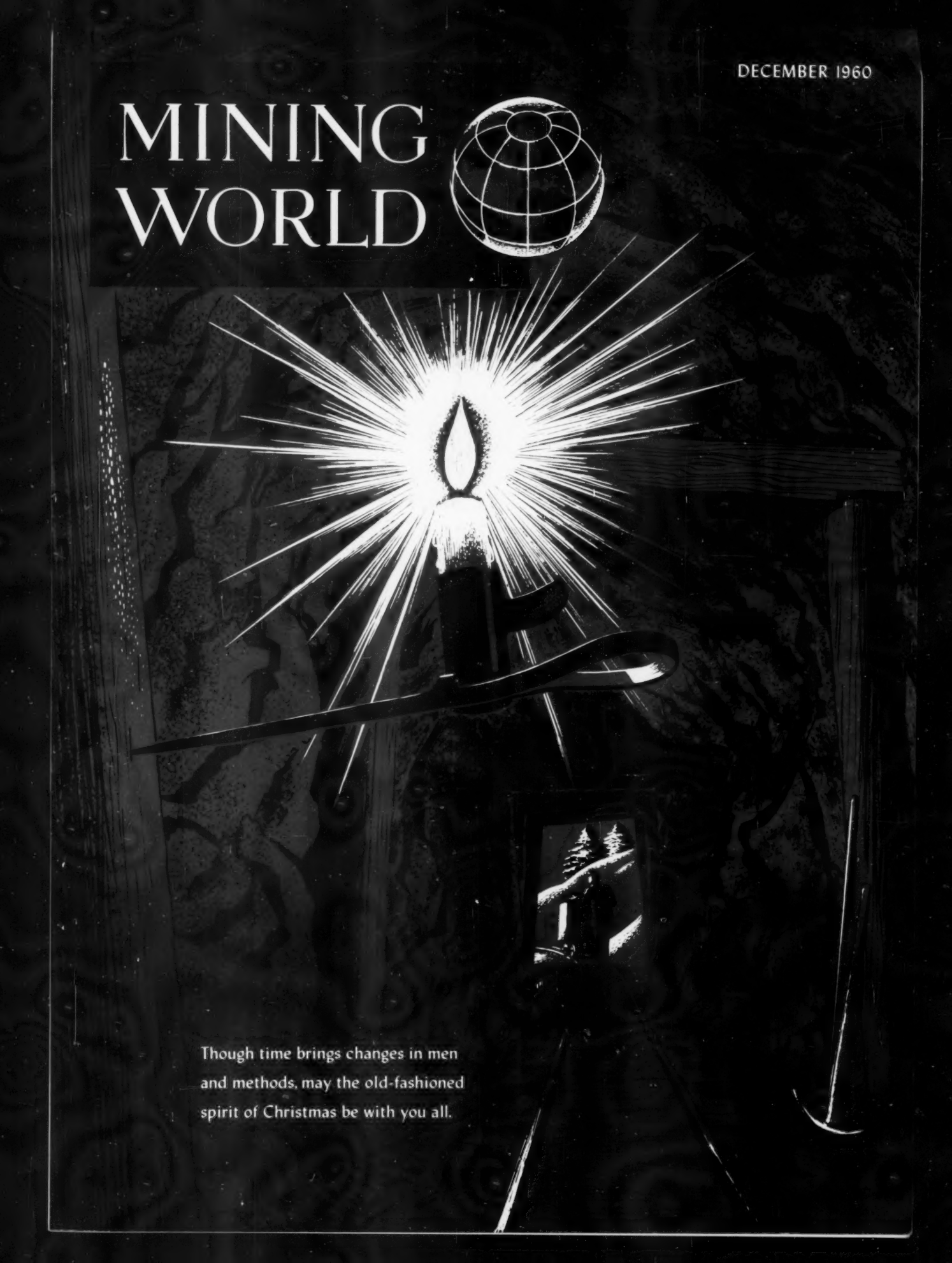
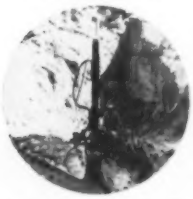
DECEMBER 1960

MINING WORLD

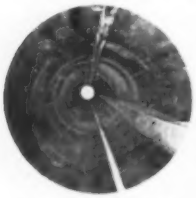


Though time brings changes in men and methods, may the old-fashioned spirit of Christmas be with you all.

Study of specifications and detail engineering.



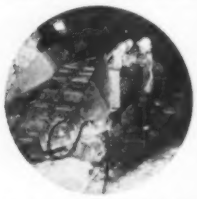
Excavation for shaft collar.



Completed 700' shaft, concrete lined.

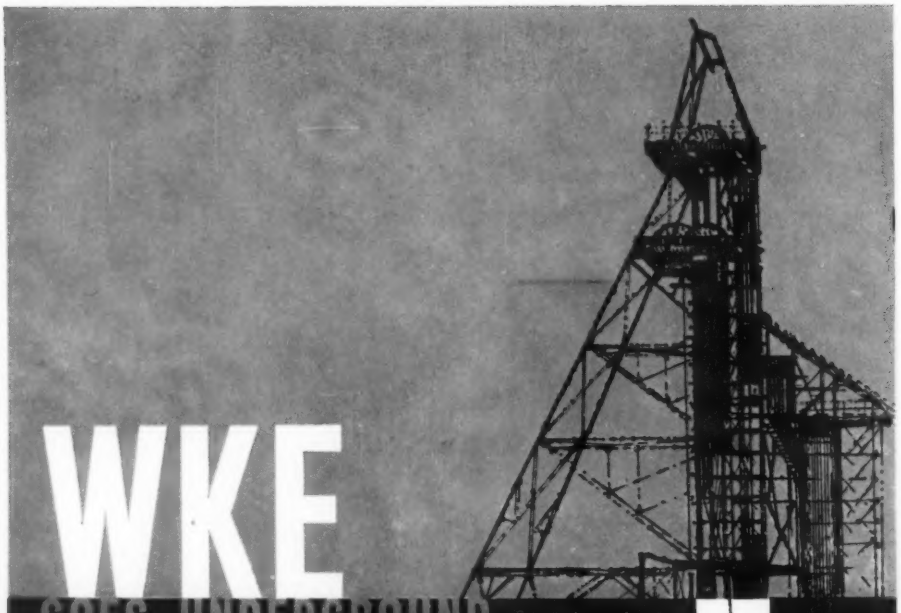
Crew readying for underground blast.

Underground control center.



Equipment lowered underground, readied for start-up.

Ready to go!



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Expensive, time-consuming blasting of overburden is a thing of the past at the Harrisonville, Ohio, strip mine of the Swisher Coal Company. Caterpillar D9 Tractors with No. 9 Rippers loosen the sandstone overburden, which is then removed by a fleet of Cat DW21 Tractors, pushloaded by D9s.

In addition to saving the cost of shooting, the Pomeroy, Ohio, company saves the cost of reclamation. DW21s spread the excavated overburden over a large area, eliminate spoil banks entirely. The overburden averages 50 feet, covers a 2-foot coal seam. Production at the mine averages from 1000 to 1200 tons daily.

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MINING WORLD

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VOL. 22, No. 13 December 1960

WHAT'S GOING ON IN MINING

DEPARTMENTS

MILLER FREEMAN PUBLICATIONS

MINING WORLD, December 1960. Volume 22, No. 13. Published monthly except April, when publication is semi-monthly at Emmett St., Bristol, Conn. Executive, advertising and editorial offices, 500 Howard Street, San Francisco 5, California. Subscription in United States, North Central and South America, $4.00 per year; other countries, $5.00 per year. Entered as second class matter Oct. 10, 1951 at the Post Office at Bristol, Conn., under act of March 3, 1879. Postmaster, please send notice 3579 to MINING WORLD, 500 Howard Street, San Francisco 5, Calif.

DENVER

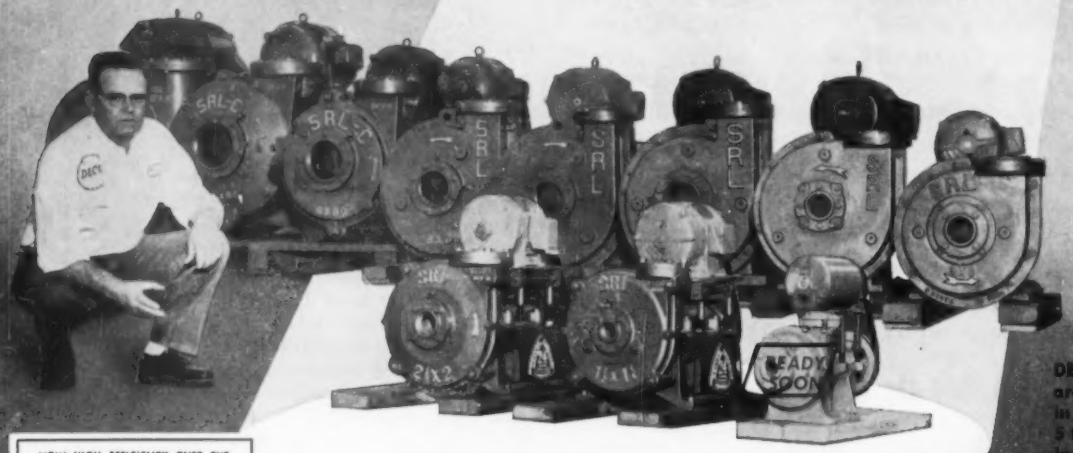
3 NEW PUMPS!

New, small DENVER SRL Pumps offer high efficiency* in low volume pumping jobs.

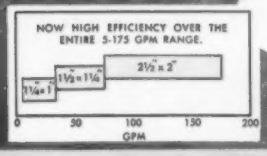
*In the past, many operators with small volume pumping problems have been forced to use larger pumps which were actually oversize for the job and were inefficient. This has resulted in reduced part life by as much as 300% and wasted horsepower in addition to less-than-expected pump performance.

These 3 new DENVER Pumps are designed specifically to offer increased pumping efficiencies in the low gpm range.

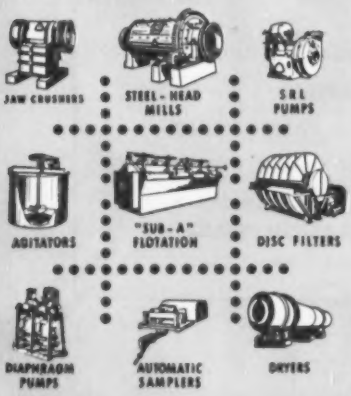
2½" x 2" for 75 to 175 GPM range
1½" x 1¼" for 35 to 75 GPM range
1¼" x 1" for 5 to 35 GPM range



2½" x 2" 1½" x 1¼" 1¼" x 1"



DENVER SRL Pumps are now available in capacities from 5 to 3500 GPM. In stock for quick delivery.



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Well Done Survey!

The outstanding work of the United States Geological Survey and its geologists is world famous, without question. For a number of years there has been a feeling that it took too long for the Survey's carefully prepared and detailed reports to be published after the field work was completed, to be of maximum value to the minerals industries.

An 'experiment' has just been published in an effort to overcome this problem. It is the first of what MINING WORLD hopes will be an annual report "to digest and make available to all, the new ideas and new discoveries that have been achieved" by the Survey in the preceding year. This 'experiment' is two volumes titled Geological Survey Professional Paper 400-A and 400-B, *Geological Survey Research 1960*, Synopsis of Geological Results, and Short Papers in the Geological Sciences. Part A is primarily a summary of important new findings, either as yet unpublished, or published during the fiscal year 1960—the 12 months ending June 30, 1960. (The volumes reached San Francisco on October 14. Fast printing and distribution). Part B consists of 232 summary papers generally less than 1,000 words long which are announcements of new discoveries or observations on problems of limited scope, regarding which more detailed and comprehensive reports may or may not be published later.

By accident, or by design, the designation "400" is most appropriate for these volumes. The "400" Professional Papers are now the elite of the geological world and join the other 400's of the social and transportation worlds.

Part A with 129 pages is well indexed and contains the list of fiscal 1960 Investigations in progress and names of geologists doing the work. Publications are also catalogued for 1960. Part B, 515 pages, is illustrated with pictures, maps, charts, geological columns, etc.

Both are available from Superintendent of Documents, Washington 25, D. C. at $1.00 for A and $4.25 for B.

Director Thomas B. Nolan asks for comments and suggestions from those who use these volumes, so that their opinions may help to determine future content.

Well done, very timely, most appropriate—and we hope only the first of many.

Check and see for yourself; then write what you think to the Director at the Survey's Washington, D. C. headquarters.

Use Annual Index

Once again, as a special service to readers the Annual Index of Printed Material for the year has been compiled for your use. It is bound right into this issue. Thus it forms a permanent and integral part of the 13 issues when you make your annual file or binding of MINING WORLD.

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GOVERNMENT ACTION AND REACTION AFFECTING MINING

New Phosphate Prospecting Permits Proposed . . .

New regulations which would provide for the issuance of two-year prospecting permits for phosphates have been proposed by the Department of Interior. The proposed changes are the outcome of legislation approved earlier this year by Congress.

According to Edward Woozley, director, Bureau of Land Management, the proposed regulations call for issuance of two-year prospecting permits, covering up to 2,560 acres each, and which may be extended for up to four additional years. The person or company holding the permit would have the exclusive rights to prospect for phosphate in the area. If the prospector holding the permit discovered a valuable deposit of phosphate, he then would be given the right to lease from the government.

Woozley explained that under the old system, applicants had to publish a notice of intent to obtain a lease. Third parties then could protest issuance of the lease and if the protest was considered valid the leasing had to be by competitive bid. When that happens, an applicant who may have made a sizeable investment in exploration would lose the benefits of his work unless he outbid his rivals. ■

Stockpile Controversy Will Be Before Congress . . .

In its semi-annual report to Congress, the Office of Defense Mobilization indicated continued active trading in some minerals and metals on long-term commitments, and some disposals of deteriorating materials such as rubber. While new commitments during the first six months of 1960 were given as totaling $459,000, the report showed that new barter agreements had been made to replace some cash commitments.

For example, all DPA foreign mica contracts were cancelled out on June 30 with seven foreign producers (whose contracts had not been fulfilled) agreeing to switch to barter terms for the rest of their commitments. The domestic mica contracts will continue to be in force until 25,000 tons of hand-cobbed mica have been acquired, which is expected during 1961.

Sales from the strategic stockpile during the six months amounted to $67,700,000, and to $9,600,000 from defense production inventories. These sales included disposals for rotation (such as rubber) and to federal agencies. The U. S. Treasury bought 10,000 short tons of copper cathodes from the DPA inventory at market price on day of delivery, and 500,000 pounds of nickel cathodes. These purchases were for the mint and represent a year's supply of the two metals for coin purposes. ■

Gold-Silver Study Sponsored By Senator Murray . . .

Under instructions from Senator James E. Murray, chairman, Committee on Interior and Insular Affairs, the committee's staff is making an over-all study of the nation's gold and silver mine production and also its position in respect to gold and silver reserve stocks.

To be covered by the study, according to Senator Murray, are the complex problems entailed in the diminishing domestic production of gold and silver in the United States and what effect, if any, such diminishing production is having on the economy and the soundness of the nation's fiscal position. He also hopes to develop recommendations for such curative measures as should be taken.

In addition to the staff studies, opinions from the field are being requested. Men active in the general mining business are being asked to express their convictions as to what, if anything, is wrong with present governmental policies regarding gold and/or silver, and what legislation or change in executive policy, if any, is necessary to increase domestic production and to strengthen fiscal position. A December 1, 1960, deadline has been set for material. ■

Millsite Locations Must Be Legalized . . .

Public Law 86-390, approved March 18, 1960, provided for the location of millsites in conjunction with placer claims by legal subdivision. Therefore, a mineral survey for patent is not required. However, according to an opinion by the acting director, Bureau of Land Management, "it is evident from the statute that there is no legal means of locating a millsite by legal subdivision in conjunction with a lode mining claim."

This opinion has resulted in the suggestion from H. J. Vander Veer and Associates, Salt Lake City, Utah, that the mining industry should immediately prepare and have introduced legislation to amend the basic mining laws to allow millsites with lode claims, located by legal subdivisions, to be patented without an expensive, useless, mineral survey. ■

Water Pollution Conference Scheduled . . .

The National Conference on Water Pollution in Washington, D. C., December 12-14, is expected to bring together more than 1,000 representatives of government, industry, and civic groups. The meeting was arranged at the request of President Eisenhower and Arthur S. Flemming, secretary of Health, Education and Welfare.

A round-table discussion, participated in by Senators Kerr and Case and Representatives Blatnik and Cramer, will outline the national water problem. Later sessions will take up: (1) the impact of water pollution on public health and economic development; (2) water resources management; (3) the legal, financial, and public responsibilities of government and industry; and (4) research and training needs. Recommendations from each session will be discussed. ■

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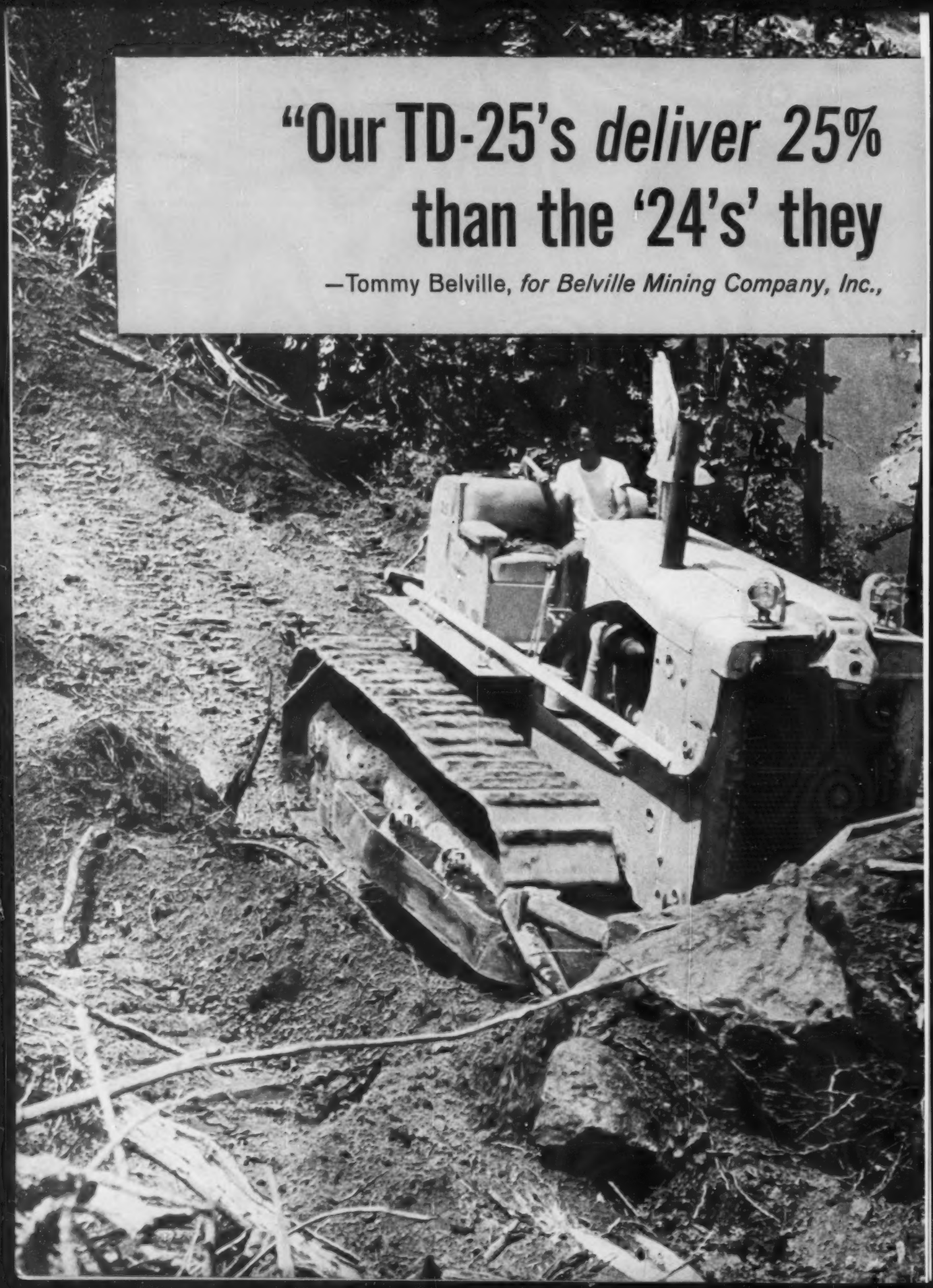

"Our TD-25's *deliver* 25% than the '24's' they

—Tommy Belville, *for Belville Mining Company, Inc.,*

more load replace"

Ironton, Ohio

"Our three International TD-25's are delivering 25% additional load, compared with previously-owned TD-24's," reports Belville Mining Company, Inc. "The TD-25 has more power to work at faster speeds without loss of motion.

"Another big advantage of the TD-25, mighty important in outcrop cutting, is you can back it up extreme grades at the faster speeds without changing gears."

"Belville" teams "25's" with a 7-cu yd dragline and a 2½-cu yd stripping shovel—to remove overburden as deep as 60 feet. The tractors are also used to level for the shovels, clean coal, construct roads.

"Live track" power-steering!

Like the TD-24, the TD-25 gives you exclusive "live track" Planet Power-steering—to make full-load, full-power turns, or slam straight ahead with offset loads. With combined on-the-go, HI-Lo power-shifting, you get instant, up-or-down matching of power to condition.

You turn with the dozer fully loaded, without spillage. You get constant-contact benching or highwalling, applying full power, getting full speed. You eliminate "dead-track drag" and "gear-shift lag."

With exclusive new International DT-817 Diesel engine wallop, the "25" bulls along, 230 turbocharged hp strong—without "slow-motion" lug-downs. New TD-25 seven-roller tracks are strength-matched to full engine effort. And the "25" is platformed on super-rugged double-box-beam frames to meet slam-bang conditions!

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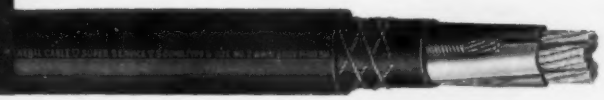

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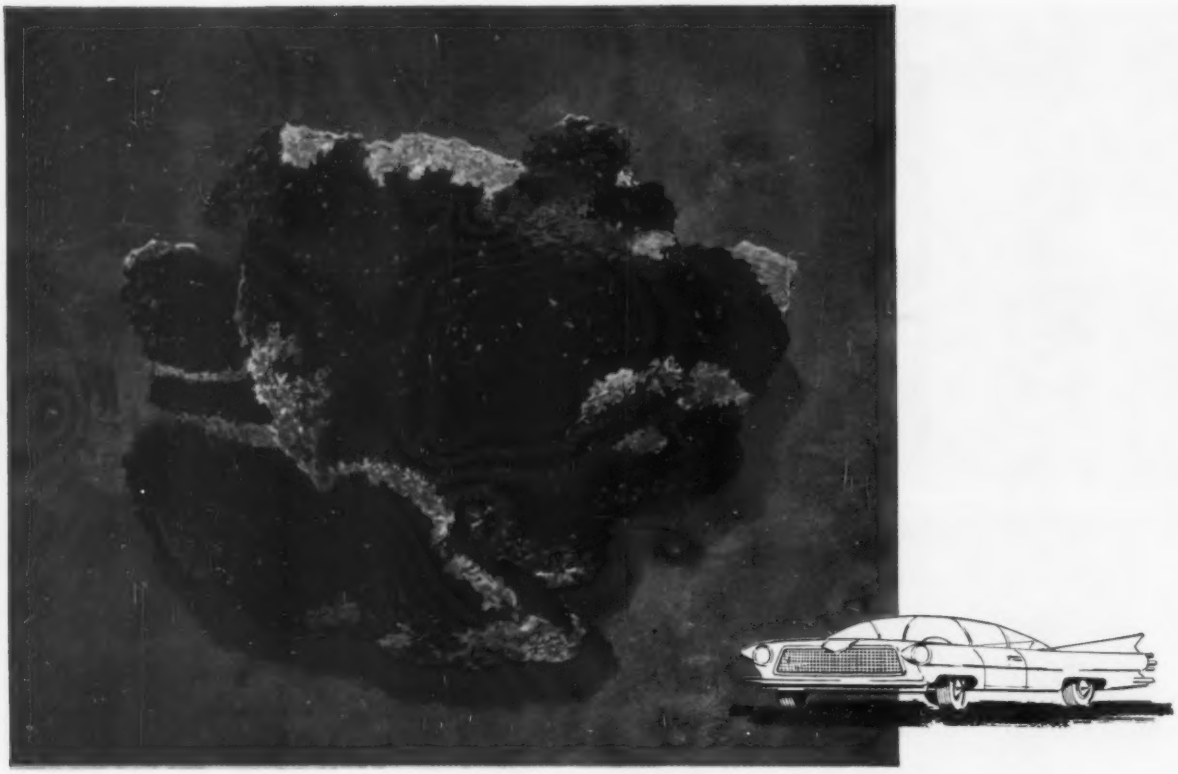

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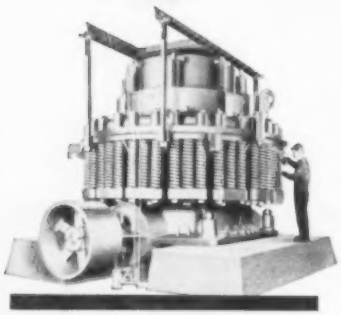

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ROTA-BLAST
RG-2JS
For extremely hard abrasive rock
(Taconite, quartzite)

ROTA-BLAST
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For hard rock
(Siliceous limestone, dolomite, sandstone, granite)

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For medium rock
(Limestone, sandstone, sandy shales)

ROTA-BLAST
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For soft formations
(Calcite, shale, clay)

Faster blast-hole drilling means more production, lower costs. In areas where blast hole drilling is the toughest, Hughes "Rota-Blast" rock bits and rotary drilling techniques, developed in close co-operation with operators and drill manufacturers, are increasing footage and penetration rate 100% and more.

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that POWERFUL SELECTIVE AEROFLOAT® PROMOTERS

Achieve Maximum Zinc Recovery

PLANT	TPD	FEED		% Zn			% RECOVERY	GRIND				
		Gangue	Sulfides	Feed	Conc.	Tails			$CuSO_4$	NaAF	A-211	ABC
A	2000	Limestone, dolomite, chert	ZnS, up to 5% FeS_2, traces PbS	4.0	60.0	0.25	94.2	18.8% + 65 Mesh 32.5% + 100 Mesh 46.8% – 200 Mesh	0.35		0.08	0.10
B	2000	Limestone, dolomite, chert, rare calcite	ZnS, traces of FeS_2	5.5 to 5.75	63.5	0.10	98.4	35.5% + 65 Mesh 48.7% + 100 Mesh 35.7% – 200 Mesh	0.44		0.07	
C	5400 total, 1790 flot.	Dolomite, chert	ZnS, traces of FeS_2 (0.5% Fe)	Flot. 8.08 HMS 3.45	61.95	0.22	96.7 (flot.)	30.9% + 65 Mesh 40.8% + 100 Mesh 41.5% – 200 Mesh	0.860*	0.092*		
D	1550	Dolomite, chert	ZnS, traces of FeS_2	4.59	64.0	0.21	95.7	42.5% + 65 Mesh 53.0% + 100 Mesh 25.5% – 200 Mesh	0.40	0.067		
E	2500	Dolomitic limestone	ZnS, traces of FeS_2	6.4	59.0	0.75	89.5	18% + 100 Mesh 60% – 200 Mesh	1.0		0.17	

*Reagents on basis flot. feed

Here are operating results from five large U.S. zinc mills showing how reagent combinations based on SODIUM AEROFLOAT or AEROFLOAT 211 Promoters produce maximum recovery in a high-grade concentrate.

While these are impressive metallurgical results on relatively simple, easy-to-treat zinc ores, both SODIUM AEROFLOAT and AEROFLOAT 211 Promoters will also do an outstanding job on more complex zinc ores and on lead-zinc ores where maximum recovery at highest grade is desired.

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Cyanamid furnishes the most complete line of metallurgical chemicals and has maintained for nearly 45 years an unfailing delivery to every world mining field. Cyanamid Field Engineers backed by the Cyanamid Mining Chemicals Laboratory will be glad to work with you to develop the most effective reagent combination of Cyanamid Reagents for your ore under your operating conditions and economics.

* * * * * *

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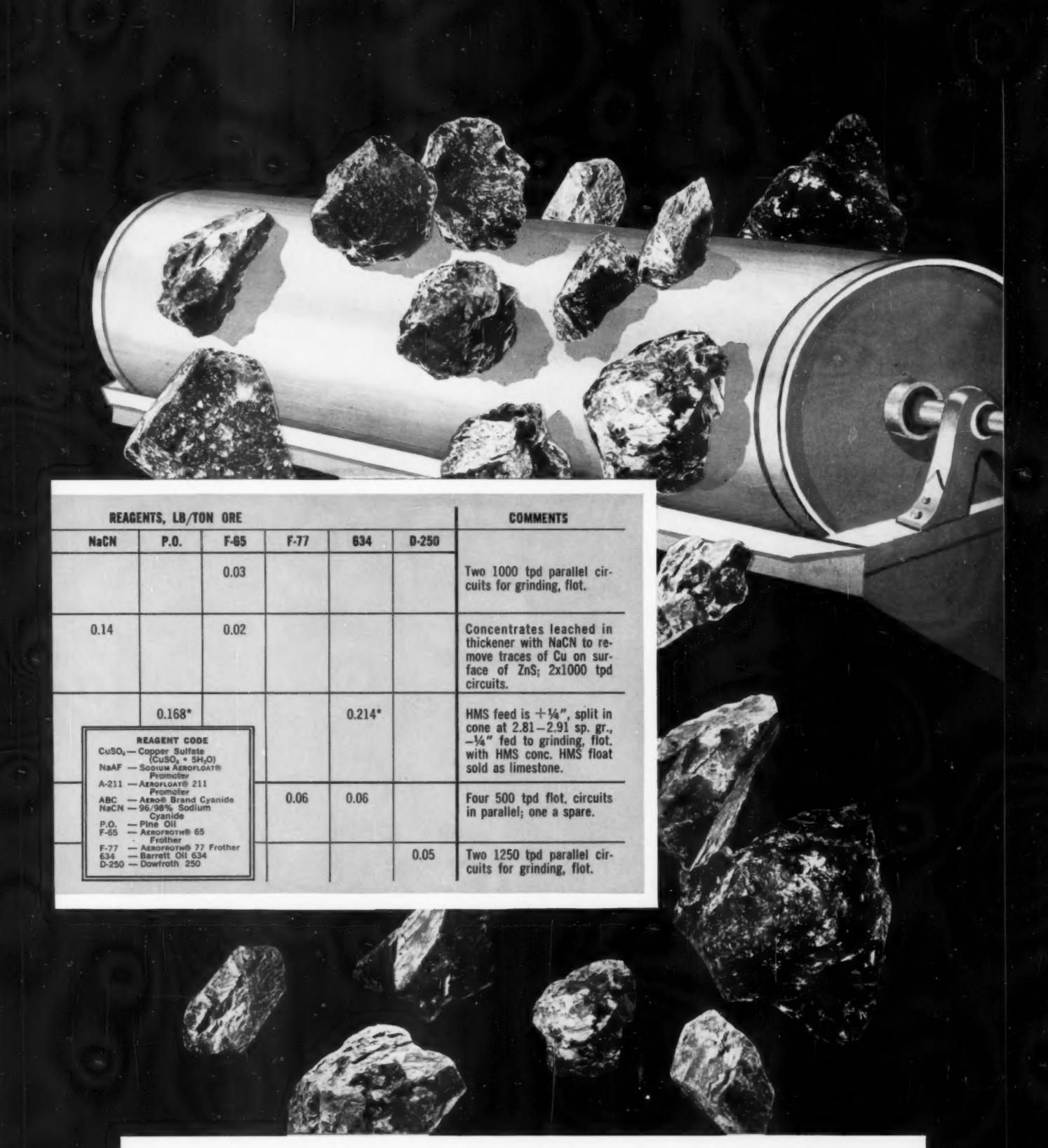
Flotation Reagents **Cyanamid Flocculants** **Chemistry of Cyanidation**
Handling & Feeding AERO® Brand Cyanide **Color Microscopy for the Mill Man**

Our nearest office will provide copies upon request.



REAGENTS, LB/TON ORE						COMMENTS
NaCN	P.O.	F-65	F-77	634	D-250	
		0.03				Two 1000 tpd parallel circuits for grinding, flot.
0.14		0.02				Concentrates leached in thickener with NaCN to remove traces of Cu on surface of ZnS; 2x1000 tpd circuits.
	0.168*			0.214*		HMS feed is +¼", split in cone at 2.81–2.91 sp. gr., –¼" fed to grinding, flot. with HMS conc. HMS float sold as limestone.
			0.06	0.06		Four 500 tpd flot. circuits in parallel; one a spare.
					0.05	Two 1250 tpd parallel circuits for grinding, flot.

REAGENT CODE

$CuSO_4$ — Copper Sulfate ($CuSO_4 \cdot 5H_2O$)
NaAF — Sodium Aerofloat® Promoter
A-211 — Aerofloat® 211 Promoter
ABC — Aero® Brand Cyanide
NaCN — 96/98% Sodium Cyanide
P.O. — Pine Oil
F-65 — Aerofroth® 65 Frother
F-77 — Aerofroth® 77 Frother
634 — Barrett Oil 634
D-250 — Dowfroth 250

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TC Gyratory Crushers are made in 7 sizes with feed openings 20" to 60" and capacities from 1,240 to over 32,000 tons per eight-hour day. For additional information, write for Traylor Bulletin No. 1126.

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Traylor TF Fine Reduction Crusher produces 5/16" to 1¼" material in large capacities. Over a half century of engineering experience is built into all Traylor crushing machinery. Write for Bulletin No. 127.


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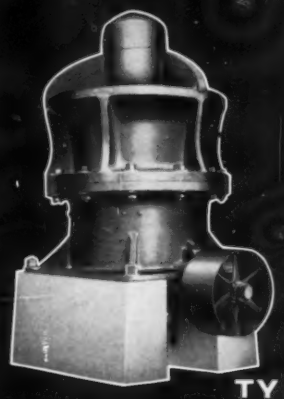
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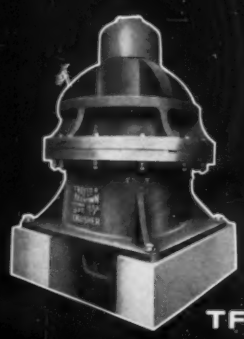
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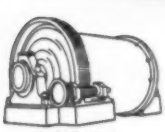
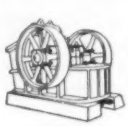

BALL MILLS


ROTARY KILNS


APRON FEEDERS


PRIMARY GYRATORY CRUSHERS


JAW CRUSHERS


SECONDARY GYRATORY CRUSHERS

Dow Introduces New Explosive and New Blasting Technique

● First demonstration in Minnesota iron mine shows new "metallized system" packs powerful punch to break holes 45 feet apart.

Jones and Laughlin Steel Corporation's Schley mine near Virginia, Minnesota, was the scene of the first demonstration of the new blasting technique of Dow Chemical Company. The demonstration was one of a series scheduled by Dow to introduce its new rock-breaking service, which ranges from engineering to actual detonation.

At the Mesabi Range mine crews used 4,000 pounds of Dow explosives to load and detonate one row of four 10-inch holes about 35 feet deep, 45 feet apart, and 27 feet from bench face. When detonated, some 40,000 tons of hard Cherty taconite was blown from the face into a well-fragmented rock pile.

Thus 10,000 tons of rock were broken per hole. This means the new system can reduce drilling costs because the high energy of the explosive permits two to three times as wide a hole spacing as with some other explosives.

The extremely safe detonation method uses a special Dow technology that is required because the explosive is so highly cap insensitive.

Holes were bottomed at three feet below bench grade. Although the Schley rock will not be loaded for the present, earlier tests show the shovel factor to be a favorable 10 to 1. After detonation, the face was extremely clean. No back break or toe underbreak problems were encountered. Secondary blasting is unnecessary.

The Dow service includes furnishing explosives, compounding them at the mine site before use, loading holes, and performing the actual detonation.

Dow has opened an explosives station at Virginia, headed by C. H. Grant. Other demonstrations and stations are planned in western mining districts.

Rotary Shaft Drilling Reaches 25-Foot Diameter

Rotary drilling tests for large diameter mine shafts are now underway at the Dallas, Texas plant of Hugh B. Williams Manufacturing Company, a subsidiary of Hughes Tool Company. A modified oil well rotary drilling rig which includes several unusual and specifically designed accessories is now making hole.

Hugh B. Williams has been one of the leaders in developing equipment for super drills for boring shafts and tunnels. It has developed and tested a prototype 40-inch diameter tunneling machine and construction of a 12-foot diameter machine is underway using many of William's ideas. Faster progress has been made in drilling large diameter mine shafts using Williams and Hughes equipment. A 44-inch diameter shaft was drilled through granite in Nevada to a 965-foot depth. Much of the drilling equipment was moved to Ambrosia Lake, New Mexico where Kermac Nuclear Fuels Corporation contracted four ventilation shafts to Rayco Drilling Company of Farmington, New Mexico. The fastest sinking rate there was 12 days to drill and case a shaft 668 feet deep.

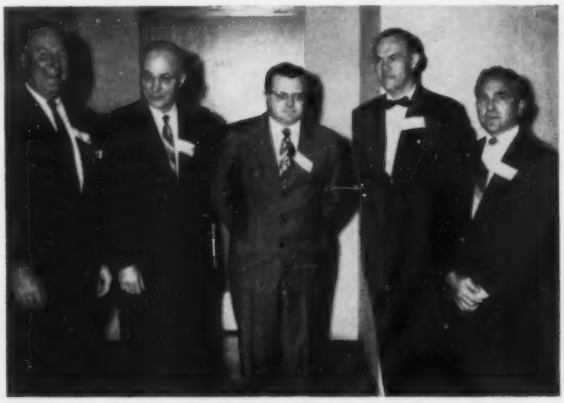
The 15-foot and 25-foot diameter test shafts at Dallas are being drilled in Austin Chalk, a soft upper Cretaceous limestone with a compressive strength range between 2,000 and 2,400 pounds per square inch.

First phase of the test is drilling a 62-inch pilot hole to a depth of 80 feet, then enlarging it to 15 feet in one reaming operation. Then the 15-foot hole is to be reamed to a depth of 50 or 60 feet and the top portion enlarged to 25-foot diameter.

Pictures at the left show (top) drilling equipment for the 62-inch hole as being lowered into the 15-foot reamed diameter, and (bottom) actual reaming process under way at Dallas.

Second phase is drilling a 12¼-inch-diameter pilot hole to a depth of 500 feet, then enlarging it to 52 inches in one operation. Drilling mud is used as the circulating medium on this hole, which simulates a ventilation hole.

New equipment that the Williams company is testing in this large-hole project include a rotary table with a 62-inch table opening; a 4,200 gallon per minute centrifugal mud pump used for drilling fluid circulation; a special crane-boom type tipping derrick mast; a string of splined tool joint drill pipe of 13⅜ inches outside diameter; four lead filled drill collars weighing 42,000 pounds each, with dimensions of 40 inches outside diameter and eight-foot length, and a 15-foot by 15-foot rolling cutting rotary bit.



NON-METALLIC SESSION opened symposium with C. D. Michaelson (left), general manager of Western Operations, Kennecott Copper Corporation, as chairman. Speakers were: Dr. G. Donald Emigh, Monsanto Chemical Company; Gordon E. Pflug, Riverside Cement Company; F. C. Appleyard, United States Gypsum Company; and Edwin R. Phelps.

ARIZONA PIT symposium tells how to

Capital of the open pit mining world was Tucson, Arizona in mid-October as pit operators and engineers attended the University of Arizona's College of Mines' Symposium on Surface Mining.

Naturally Arizona operators—led by Phelps Dodge Corporation, Kennecott Copper Corporation, American Smelting and Refining Company, and Inspiration Consolidated Copper Corporation—had the greatest number of engineers in attendance. Official registration reached the 200 mark for the two days of technical papers, an evening session on computer operation, and the final day's field trip to the new open pit Mission copper mine of ASARCO. Students and other part time participants swelled the total to 250.

Excellence of the program arranged by the Symposium Committee under chairman Harry E. Krumlauf, professor of mining engineering, was demonstrated by the large registration from all parts of the world. The largest foreign delegation was from Mexico with copper and iron miners in attendance. Five engineers came from Atlas Consolidated Mining and Development Corporation, Philippine Islands, operator of the largest open pit copper mine in the Far East. Asbestos miners from Quebec led the Canadian engineers. Venezuela sent iron miners from Cerro Bolivar. Registered from England were engineers who operate pyrite pits in Spain and came to Arizona to see copper mines in preparation for design of a new major South African copper pit.

One of the Symposium highlights was a demonstration of what a digital computer is, how it operates, and what

Computer determines shovel performance at University, ore

by Elmer R. Drevdahl
Associate Professor
Mining Engineering
University of Arizona

An equipment research program is being developed at the University to establish a standard procedure for estimating the approximate cost and output capabilities of heavy equipment in various mining situations.

It has been found advantageous to express equipment capabilities in the form of mathematical expressions so as to facilitate the development of computer programs that compute equipment output and costs. These are then used to determine the effect of a wide range of operating conditions on mining equipment systems. Computer programs have been developed for mining system analysis that will handle over 20,000 combinations of input data using an IBM 650 digital computer.

As these computer programs are developed, they are added to the departmental library of computer programs available for industry use.

The first of these programs has been developed for "Estimation of Shovel and Dragline Output" and is broken down under output in loose or bank measure in cubic yards per hour, and the approximate number of trucks needed to service a shovel or dragline with a computed output.

by Richard F. Hewlett
Research Fellow
Department of Mining
University of Arizona

A comparison of the polygonal, triangular, and statistical analysis methods of estimating ore reserves was made with the production records from a mined-out portion of American Smelting and Refining Company's Silver Bell oxide pit near Tucson, Arizona. This study was made possible by utilizing a digital computer for all of the computations.

From this study the following conclusions have been made:

The triangular, polygonal, and statistical methods should all be used and a comparison then made of the results to determine the ore reserve estimates. Use of the digital computer for ore reserve computations yields more precise and consistent results with a great saving in time and money. Realistic total costs for ore reserve computations using three methods would range from $300 to $3,000. The cost depends mainly on the number or separate computations made with each method for various vertical intervals.

SOUTHWEST PIT PRACTICES were outlined by speakers. From left are: Martin J. Hughes, Kaiser Steel Corporation; H. E. Krumlauf, chairman of the University's Symposium Committee; Thomas M. Anderson, Inspiration Consolidated Copper Company; T. A. Snedden, session chairman, American Smelting and Refining Company; and Harry M. Conger, ASARCO's Silver Bell.

PHILIPPINE ISLAND delegates were all from Atlas Consolidated Mining and Development Corporation. From left are: Charles Smith, A. M. MacLeod, Jose M. Soriano, Don Andres Soriano, and Mose Kelley. Atlas is the largest open pit copper miner in the far east and its delegation was largest from any company and country outside North America.

use computers with drills, trucks, and shovels

it can do for the open pit operator. General Browning of the University staff had a computer on the stage wired through a special board into the recording and printing unit. The special board had several hundred colored lights wired into the computer circuit. Elemental problems were fed into the machine to show how two numbers were multiplied. The multiplication process was then flashed on the special board with lights to show how the product was then stored for future use. The pitfalls of computer use were also shown when the wrong program was inserted in the machine and no solution was made. Thus the need for careful analysis, development of mathematical expressions, and establishment of computer programs was forcefully brought to the attention of everyone.

Proposed computer symposium was tentatively announced as a four-day course on "Computers and Computer Applications in the Mining Industry." If a minimum of 30 engineers register for this course at $100.00 per registrant, a course will be held April 4 through 7th, 1961, at the University. All engineers interested in attending should write to Dr. James D. Forrester, Dean, College of Mines of the University for further information.

Abstracts of some of the most important papers are presented below.

Published proceedings of the Symposium will be distributed to all registrants. Extra copies will be printed and can be purchased for a nominal sum from the University. Write the College of Mines for cost and delivery date if you are interested.

reserves at Silver Bell, and evaluates Pima pit expansion

Precise location of the pit limits is not critical for computing statistically the grade of the waste, leach, and ore. The effect of the pit limits on the ore reserve computations is sufficient to justify computations using different proposed pit limits in order that a better estimate of tonnage and grade be obtained. These preliminary pit limits can then be used as basic information for future mine and mine plant design calculations.

by James F. Olk
Chief Mining Engineer
Pima Mining Company
Tucson, Arizona

About the middle of 1959 Pima Mining Company engaged in an exploration drilling program to check the feasibility of an expansion of the present pit. Speculation was made as to whether the calculation of this rather small expansion was feasible with a computer.

To obtain this result, certain specific data must either be calculated, or be available, or be assumed. First of all, the volumes of waste stripping and the tonnage and grade of ore must be calculated, first to an assumed or "trial" limit, and then inward or outward in increments until the economic limit is reached.

First were the volume calculations based on vertical sections every 20 feet on each bench so that the length, width, and height for each volume were measured or scaled from maps. Alluvium, rock, and ore were kept separate. Thus volume for each bench was the summation of segments, and for pit it was sum of benches. Punched cards were then set up for each segment with the three dimensions. The University's IBM 650 digital computer then calculated and stored each volume. Thus, volumes for each increment in each bench, the total increment and cumulative total of increments by bench and total, all broken down into alluvium, rock, and ore, were stored.

The machine now follows a logical series of steps in order to calculate the economics of the increment. The factors, costs, and other constants to be used in this calculation have been introduced by punched card and filed in the machine, and the succession of steps is outlined by the program. First the volumes are converted to cubic yards or tons and the ore tonnage and average grade is calculated. The waste stripping totals are multiplied by the unit costs, the ore by the unit cost, and this total divided by the tons of ore to get the direct mining cost per ton. Other fixed costs are added, such

as milling, depreciation, overhead, etc., for a total cost per ton. Then the value of the ore is determined. The amount of recoverable metal is determined by introducing a recovery factor and this is multiplied by the value per unit of metal, either market or FOB mine depending on individual custom, and the value per ton is determined. The difference between the value per ton and the costs gives the net value of production. This can be determined for various metal prices.

The data cards are punched, one per section per increment, with the following information on each card: the bench number, the three dimensions, conversion factors and the grade of ore. The cards for each increment were followed by a card with unit costs, milling costs, and other costs. These cards are preceded by the program deck, or instruction cards, and cards containing metal prices and other instructions. These are read into the computer, the computer performs its required functions, and the results

ELECTRIC SHOVELS are used for waste and ore loading. Here are two 190B Bucyrus Erie shovels on waste bench.

How Kaiser drills and blasts

by Martin J. Hughes
Manager, Eagle Mountain Mine
Kaiser Steel Corporation

Kaiser Steel is now mining and stripping its East Pit at Eagle Mountain, California where 108,675,000 tons of ore will be mined. Stripping ratio is 3.2 waste to 1.0 ore.

A large hill on the north pit scarp contains about 12,000,000 tons of extremely hard jointed quartzite which must be removed for pit development. This material is so hard that ordinary drilling methods are not applicable.

All currently available methods of hard rock drilling, including jet piercing, were considered and tried at Eagle Mountain. As a result of this study, it was determined that the Ingersoll-Rand down-the-hole drill is best suited for the job.

The nine-inch down-the-hole drill was perfected at Eagle Mountain and six of them are now used. Average drilling rate is 25 feet per hour and tungsten carbide bit life is 850 feet.

The 9-inch holes are drilled on 16½-foot centers. All

Truck mounted rotary cuts Inspiration drilling cost; Silver

by Thomas M. Anderson
General pit foreman, Inspiration Consolidated Copper Company
Inspiration, Arizona

Inspiration operates two pits—Live Oak and Thornton—with part of each over old underground workings where no drilling or blasting is necessary. However, 50 percent of material in pit must be drilled and blasted for current output of 105,000 tons of ore and 75,000 of waste per week.

A study of drilling requirements in the light of the somewhat unique operation indicated that if the full drilling potential of a rotary could be realized, we could do all our drilling with one machine. In order to do this it would be necessary for the machine to be highly mobile and be able to make preparations to move with a minimum of lost time.

After much study and deliberation, we purchased a truck-mounted drill capable of drilling a 6¼ inch hole. This was a Joy model 225, mounted on a GMC long wheel base cab and chassis, with a separate power unit for rotary and compressor drive and a hydraulic controlled mast. A water injection system was installed in our shops for dust control.

Comparison of drill and bit performance and costs are given below.

Churn Drill Versus Rotary Drill at Inspiration[1]

Item	Churn	6¼-inch rotary	9-inch rotary
Feet per shift	1.0	5.70	4.90
Cost per foot	1.0	0.39	0.50
Cost per ton	1.0	0.96	0.59

1. 1955 churn drill performance as 1.0 base.

Rotary Drill Performance at Inspiration[1]

Drill	Feet per shift	Feet per bit	Bit cost Cents per foot	Tons per foot of hole[2]
Joy, 6¼	390	1,200	7.8	46
Reich, 9	343	2,350	7.4	95

1. First six months 1960. 2. For 50 foot bench.

We enjoyed very little savings in cost with our first rotary drill in comparison to a 9-inch churn drill because it took twice as many holes to break the same amount of rock. However, the new drill had many important operational advantages over the old churn drills. Some of these advantages were: the convenience of not having to supply drill sites with power, water, casing, bits and miscellaneous supplies; the reduction in manpower required for drilling—six churn drill crews replaced by two rotary drill crews; the mobility feature which made it possible to "knock-down," move from one pit to another and set up to be ready to drill in approximately 30 minutes.

In 1959 the company shipped a surplus Dart truck chassis to the Reich Drill Company which installed a new model T-750 drill on it capable of drilling a 9-inch hole. It is equipped with a separate power unit, two 540 cubic foot per minute compressors, hydraulic-controlled mast, hydraulic pumps for the rotary drive, pull down and leveling jacks and a hydraulic water pump for dust control.

For the month of August, 1959 the drill averaged 1.1 moves per operating shift. The average distance traveled per move was 7,900 feet. Present record for footage in an eight hour shift is 480 feet.

by Harry M. Conger
Mine shift boss, American Smelting and Refining Company
Silver Bell, Arizona

are printed on a continuous roll of paper.

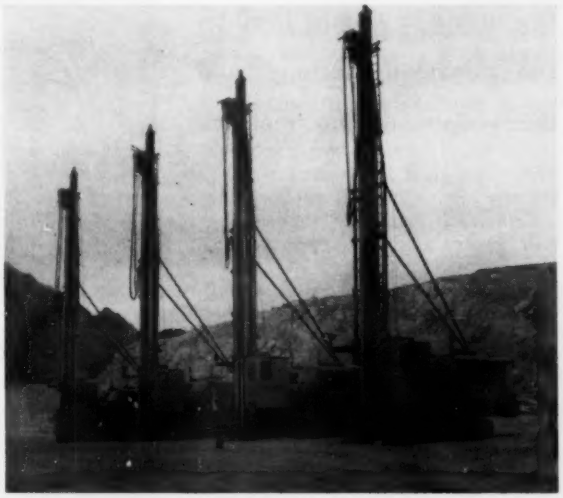
In our problem, we had the following data for each increment printed out on a continuous roll in neat, logical and tabular form: the cubic yards of alluvium stripping required, the cubic yards of waste rock stripping, the tons and average grade of the ore, the direct mining cost, the total cost, the stripping ratio and the total volume of material to be moved. Totals for each increment were obtained and in each increment sub-totals by benches. For the increment, the value per ton for five different prices of copper was shown and the net value of production for those five prices. Then, after each individual increment, the cumulative total of that increment and all previous ones was shown, also broken down by bench total and grand total. With this information, the economic limit of the expansion could be picked out easily, as that increment where a loss or a sharp drop in net value was shown would be the limit.

hard rock at Eagle Mountain

holes are drilled to a depth of 15 feet below the bench.

In most of the pit areas, the holes are loaded with an explosive agent which is made up of uncoated agricultural grade ammonium nitrate which is treated with Diesel fuel. Eight tenths of one gallon of fuel is added to each bag of ammonium nitrate before it is placed in the hole. Greatest attention is given to the methods of detonating or boosting the explosive charges. Originally, 180-grain primacord was used as a detonating agent. However, continuous experimentation has shown that higher speed and better explosive results can be obtained by using pentolite boosters which are placed at intervals from the bottom to the top of the explosive column.

In certain parts of the pit, extremely hard rock is encountered. In these areas, an explosive charge which is made up of quarry gelatin and emulsified ammonium nitrate oil slurry is required. Holes are detonated by primacord and no delays are used. The overall powder factor is 1.30 pounds of explosive per cubic yard of material blasted. In the very hard rock, a powder factor of 2.8 pounds of high explosive per cubic yard of material is required.



DOWN-THE-HOLE drills have proved very successful for the hard rock. Here are four Ingersoll-Rand Quarrymasters.

Bell uses detergents to increase bit life and drilling rate

The use of a detergent in the rotary drill water at Silver Bell has shown these three advantages: 1. Better dust control with less water; 2. Faster bit penetration; 3. Longer bit bearing life allowing more retipping of worn bits.

Three major rock types are found at the two pits. One type is a porphyry, both monzonite and dacite. This rock is considered to vary from soft to medium in hardness and drillability. The average drilling penetration in this rock is two feet per minute. The second is alaskite which is rated from medium to hard, depending on the alteration. Medium ground has a penetration rate of 1.5 feet per minute. The fresh alaskite is hard with a penetration rate of 0.8 of a foot per minute. The third rock type is a hard, highly abrasive silicified sediment. This rock has an average penetration rate of 0.6 of a foot per minute.

Roller cone bits are used to drill 9-inch diameter holes to a depth of approximately 53 feet by two Bucyrus-Erie 40-R rotary drills.

To permit a reduction in the amount of drill water used, while maintaining a safe dust count level, a detergent was tried. Detergents have been used for over a year and a half now and with their ability as a wetting agent, the dust problem has been virtually eliminated. Further, the drill water consumption has been reduced by 50 percent.

The use of a detergent has another advantage which, from an economic standpoint, out-weighs its dust control properties. Roller cone bits are designed as a one use item; that is, after the teeth and gauge are worn off, the bit is to be discarded. Therefore, the roller cones revolve on dry bearings. By continuously introducing detergent molecules to the bearing surfaces, via the drilling water, the bearings are, in effect, lubricated.

Test results prove that the same rotation speed can be maintained with a 25 to 30 percent increase in the down-pressure. This has increased the penetration rate by an estimated 10 percent.

Drill footage averages for 1958 (before detergent use) and for 1959 (when added) show 290 feet per shift in 1958; 339 in 1959. Feet per bit in 1958 were 919; 710 in 1959. Feet per retipped bit in 1958 were 457 in 1958 and 580 in 1959.

The reason that 1959's new bit average is lower than in 1958 is that a large amount of 1959's footage was drilled in a hard, abrasive, silicified sediment. Yet, in spite of these adverse drilling conditions, the overall shift average for 1959 was higher than in 1958.

A pound to a pound and a half of Pilot Company of California's HD 90 dodecal benzine sulphonate is added to 100 gallons of water. The chemical is in powdered form and is put directly into the water tank on the drill. The slight mixing necessary is accomplished by a blast of compressed air from a blow pipe. The average daily cost of the detergent is about 40 cents.

From the water tank, the water-detergent mixture is injected into the bottom of the compressed air standpipe on the derrick by means of a piston-type pump. The air flow then carries the mixture up the standpipe, through the traveling connecting hose to the drill head, and then into the drill stem. By the time the mixture reaches the stem, it is agitated into a froth.

The detergent has no adverse effect on mill flotation. END

This is the second of two Northern Rhodesian Copperbelt articles specially prepared by MINING WORLD's travelling correspondent in Africa. The first article in August 1960 issue described geology and the various mining methods

NCHANGA open pit with the LMG bucket line at end of stripping cut ready to start on lower bench. The electric shovel is loading ore from drop cut.

Mining World photograph

NKANA South headframe and ore bins. Over 200 miles of annual development is done on Copperbelt to prepare for sublevel stoping, panel caving, and open stoping.

Why Copperbelt Minerals Complicate

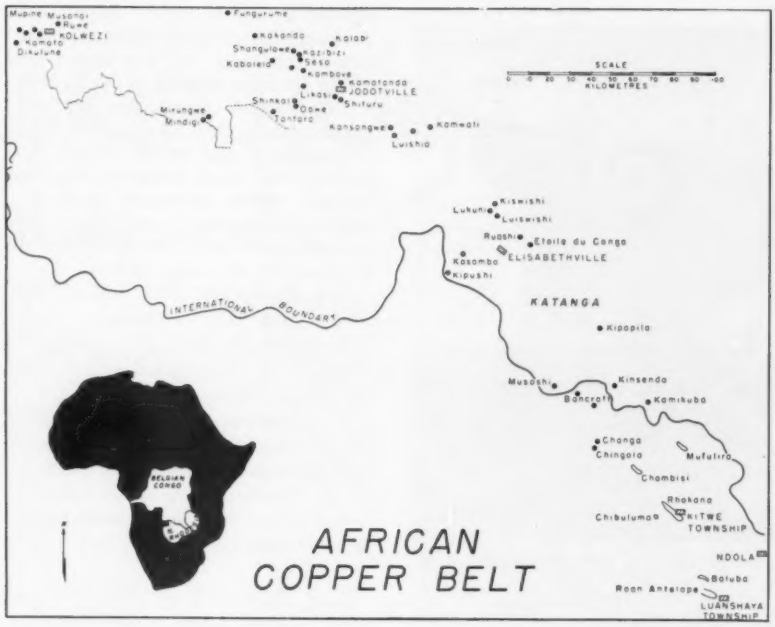
The great mineral province of Northern Rhodesia's Copperbelt is now producing 580,000 long tons of copper and important byproducts cobalt and selenium each year. Expansion of mining, milling, smelting, and other facilities are underway to increase production when needed.

With a total declared reserve of almost 1,000,000,000 tons of ore with a grade of 3.5 percent copper the Copperbelt is one of the largest future sources of copper.

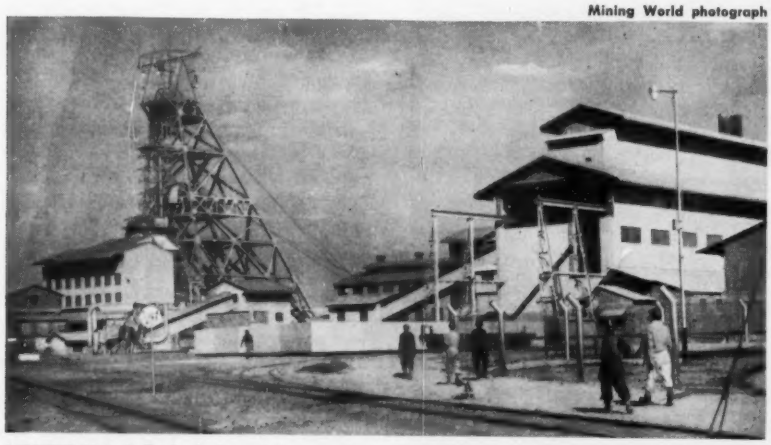
Ore shows amazing uniformity of mineral concentration within relatively thin argillaceous sediments. Folding is strongest structural feature which means steep to flat dipping ore bodies extending to great depth. Underground mining predominates, but two open pits have been recently developed.

Six companies—Bancroft Mines Limited, Chibuluma Mines Limited, Mufulira Copper Mines Limited, Nchanga Consolidated Copper Mines Limited, Rhokana Corporation Limited, and Roan Antelope Copper Mines Limited—operate six underground mines and two open pits.

Each mine has its own concentrator, with broadly uniform and standard practices. Jaw and gyratory breakers, Symons Standard and Shorthead crushers, ball mills, rake classifiers, flotation with a variety of reagents, Dorrco or Eimco filtration—these have been the common makeup of plants with some $40,000,000 in aggregate capital cost and a stratifying factor tending to deter major changes. Recent replacements include rod milling



Mining World photograph



MUFULIRA Selkirk shaft and fine crushing plant. Coarse crushing is done underground for more efficient skip loading. This shaft serves mine to 2,000 foot depth.

Metallurgical Recovery

for ball, hydro-cyclones for rakes, Agitair mechanical flotation units for airlift machines.

Irregularities of feed are manifold—in the mixtures of sulphide, "oxide" and cobalt elements; in relation of chalcopyrite to bornite or chalcocite; presence of irrecoverable chrysocolla; and in the degree of fine-grinding for good extraction.

The gangue is siliceous, with small percentages of alumina, lime and magnesia.

Mufulira initiated underground crushing, for good skiploading, followed by Bancroft and Rhokana. This mine, in process of expansion, mills over 4,400,000 tons per year at 2.7 percent copper, yielding a 47 percent concentrate for an extraction of 92 percent or, excluding a small fraction of "oxide," 94 percent.

Roan treats 5,500,000 tons at 2.0 percent for a 36 percent concentrate and extraction of 84 percent. Here, and at Mufulira, concentrator costs are roughly 40 to 70 cents per ton.

At Nchanga, with a mill head grade of 5.0 percent, half in sulphides, half in "oxides," tailing loss is inevitably high, at 0.8 percent copper. When milling at an annual rate of 3,700,000 tons, two concentrates are produced —200,000 tons of smelter grade (38 percent copper in sulphides and 9 percent in "oxides") and some 500,000 tons of leach grade at 12 percent in oxides and 1.7 percent in sulphides, producing 60,000 tons of cathode copper for dispatch to Nkana. Rarely has concentrator construction followed such a lengthy test in a large-scale pilot plant. Six years of operation and the production of 96,000 tons of copper preceded final decisions on the Nchanga flowsheet.

Bancroft is also a high-grade mine with oxide complications. On a mixed head value of 4.4 percent, differential flotation gives an overall extraction of 87 percent in a 30 percent concentrate sent to Nkana for blister production.

Settlement of tailings has always been a major Copperbelt problem due to summer storms and an unstable product. Dam-wall building with a coarse fraction taken out by hydrocyclones has been successful.

Cobalt

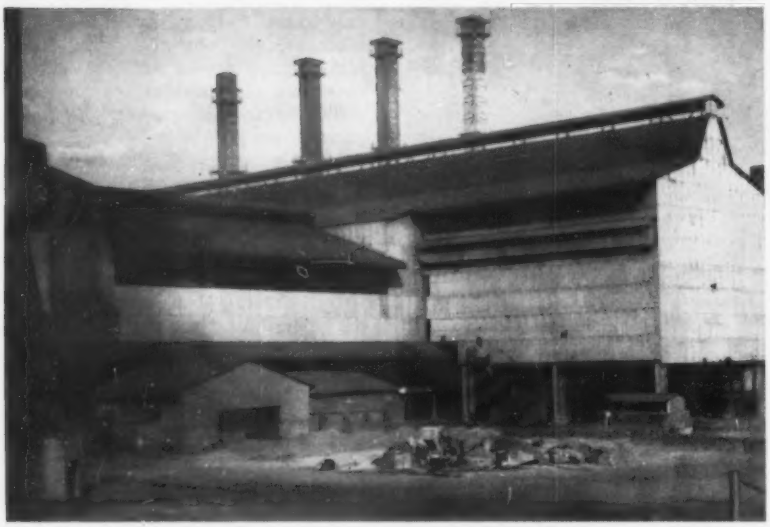
Practice at Rhokana concentrator, with its capacity of 400,000 tons per month, is complicated by an average cobalt content of 0.17 percent. Cobalt production started here in 1933, accounting for almost the entire Rhodesian yield to date of $85,000,000 in value. Profits are not shown in company reports.

The cobalt concentrate, 25 percent of the flotation total, contains 17 percent copper and 2.8 percent cobalt in carrollite. This is sent to a cobalt plant for roasting on multiple hearths, converting the sulphide to soluble sulphate for leaching. Copper and iron are precipitated out in the purification section. The final thickener overflow passes to the tank-house for electrolytic recovery of the cobalt on steel cathodes for shipment overseas in that form, or as granules produced by remelting in an arc furnace.

Chibuluma produces a cobalt concentrate of 3 6 percent cobalt and 3.3 percent copper (80 percent extraction), which is treated at the new Ndola refinery, for production of a matte of 9.0 percent cobalt and 12 percent copper. This matte is shipped to the Hoboken Company's plant at Olen, for final metal recovery. Both Rhokana and Ndola are now using FluoSolid roasting methods on these cobalt-copper concentrates.

The Copperbelt is served by three big smelting plants, two of which have integrated refineries—Mulfulira

Mining World photograph



MUFULIRA smelter has the largest reverberatory furnace, 110 feet long, on the Copperbelt. Most of the blister copper is cast into anodes for local refining.

and Rhokana (jointly with Nchanga).

The third refinery is the recently commissioned plant at Ndola, costing $13,000,000, which is a subsidiary of Roan Antelope. Roan erected first anode and casting plant during 1958.

The proportion of Rhodesian copper shipped as electrolytic has risen, since 1953, from 40 percent to 70 percent.

The Rhokana plant, with an annual capacity of about 240,000 short tons of blister and electrolytic copper, ranks among the world's greatest. Storage bins could carry 35,000 tons of concentrates from Nkana, Nchanga and Bancroft.

Five reverberatory furnaces, fired with pulverized Wankie coal, are 100 feet x 32 feet, comparing with the latest built for $2,500,000 at Mufulira, which is 110 feet in length. Good reverberatory practice has demanded abnormally close coordination of technical control in the efficient treatment of variable concentrates from different mines, though of the same group.

Rhokana's five converters, of standard 13 x 30-foot size, are followed by a holding furnace to serve the substantial export of blister, and three furnaces for the casting of 99.8 percent refinery anodes. The anode slime is dried for shipment at 30 percent to 40 percent copper, with appreciable silver, selenium and gold. The most impressive feature of the refinery is the great tank-house section, 690 feet by 300 feet, with a rated full capacity of 170,000 short tons per year.

Both mining groups have well-equipped central laboratories for study and research. There is pressure for increased automation in all metallurgical branches.

A flowsheet for the Chambesi mine and the applicability of a roast-leach process for Kansanshi are under investigation.

Mine labor

In African mines, the three parties in the "eternal triangle" are the management, skilled white labor, and African labor of lower skills. Application of the "color bar" has been a frequent issue for dispute. Two staff associations and two mine workers' unions, white and African, deal with management and each other. Recently, the labor position has improved. Better machinery exists for settling disputes, and, probably enough, employees have come to realize they are all pretty well off.

The Copperbelt force totals 7,000 whites and 35,000 Africans—a ratio very different to the 1:10 prevailing in Katanga, for operational rather than for policy reasons.

A generation ago, the local native mine worker compared poorly, in skill and physique, with opposite numbers in the South African gold and diamond mines. His rapid development reflects great credit upon the copper companies.

The African mining employee has always shown great aptitude for routine and repetitive tasks. The sterner test will come when he is called upon to exercise more fully the qualities of judgment and initiative. Much patience will be needed. Fitness to shoulder responsibilities in an industry so inscrutably complex as that of Rhodesian copper can come but slowly to a people barely redeemed from a primitive tribal life.

Estimate 18 cents per pound copper cost for an average ore grade of 2.5 percent

A declining grade of ore and rising cost of metal can be foreseen throughout Central Africa. The mines are getting deeper. Wages will increase. Inflation continues and profitable industries may be called upon by governments to carry heavier burdens—to the detriment of enterprise and progress.

On the Copperbelt, the average yield has dropped from 3.1 percent to 2.7 percent copper in the last six years, in spite of the advent of the rich Bancroft and Chibuluma. Two mines, little affected by policy changes—Roan and Mufulira—have shown in ten years a drop of 20 percent in the grade of ore milled.

Fair comparisons of working costs cannot be attempted between mine and mine. A broad picture may best be presented by estimating the expenditures on a hypothetical Copperbelt mine, annually milling 5,000,000 tons of 2.5 percent copper mill head grade in sulphides. Reasonable assumptions would be:

	Per Short Ton Copper
Mining, milling, concentration and general mine expenses (24 s. per ton milled)	£ 54
Smelting and Refining (electrolytic)	£ 16
Administration, sales, bonus to employees, pensions, etc.	£ 14
Royalty (at £ 215 short ton copper price)	£ 22
Rail, port shipping charges, insurance	£ 20
Delivered cost per short ton	£ 126

The Royalty charge is 13.5 percent less £8 per long ton. This royalty with bonuses has an important cushioning effect in bad times on the profitability of the field. END

SKIP HOIST speeds ore out of Kennecott's Liberty Pit in one minute

The Kennecott Copper Corporation at Ruth, Nevada, now has a fast and efficient method of moving ore from the lower levels of their Liberty pit. Installed at a cost of about $1,500,000, a new inclined skip hoist speeds 25 tons of copper ore out of this large mine in about one minute as compared to 10 to 15 minutes by truck!

Completed in June of 1959, the skip hoist now carries more than 12,600 tons of ore a day out of the pit—or approximately 60 percent of daily ore production. The balance of ore production is still hauled from the upper benches by trucks.

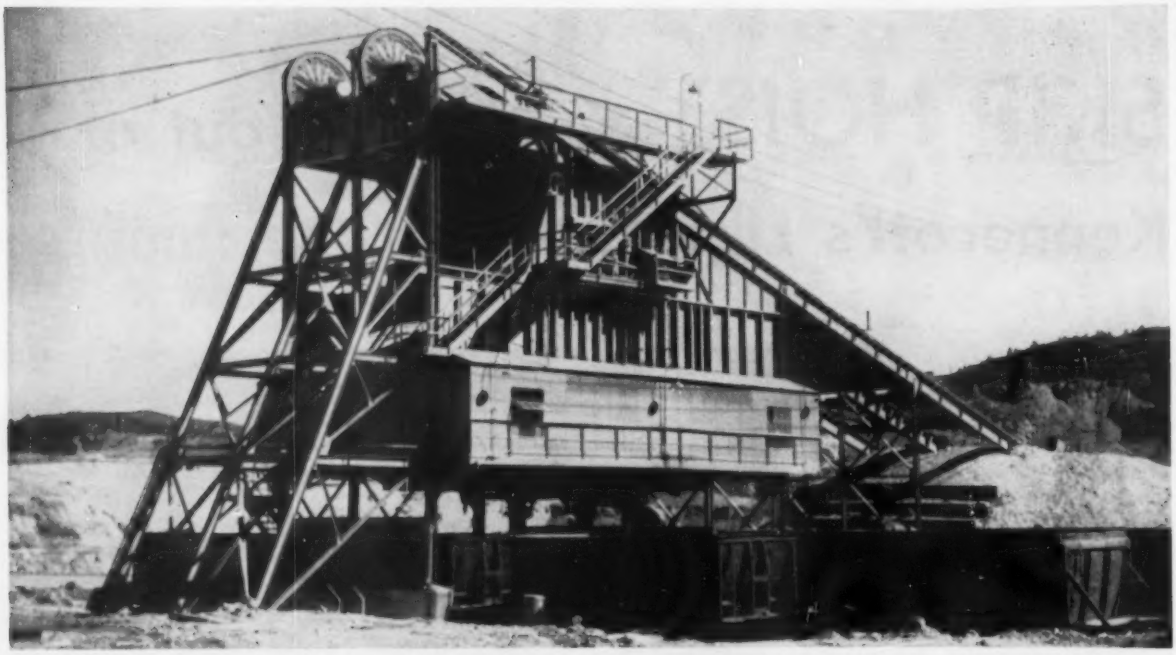
The decision to build the skip installation was the result of careful planning by Kennecott engineers from 1955 to 1958. During these years the Liberty pit was converted from rail haulage to truck haulage. However, as the pit expanded, it was seen that a combination of truck haulage-skip hoisting would probably be best suited for operational needs. Truck haul roads were approaching a distance of two miles from the lowest loading point to the pit perimeter, with an average grade of seven percent. The time required for the one way trip was up to 15 minutes. Truck haulage costs were high and as the pit deepened they would inevitably increase. Thus, the decision to install the new skip system was both sound engineering and good economics.

Construction on the skip installation was started in May 1958 and completed in June 1959. Over 500,000 tons of material were excavated for the skip trackway by bulldozers and shovels with a tractor mounted drill for blast holes, and approximately the same amount for the loading trackway. The skip operates three shifts a day, seven days a week, and is shut down one 8-hour day shift a week for preventative maintenance.

The skip is located in the middle of the north side of the pit which has an overall slope of 23°. The skip slope, though, is 19° 04′. The trackway for the skip system from the loading point to the dumping point is 1,234 feet long with a vertical raise of 405 feet to the top of the headframe. The loading station at the bottom is on the 6,704 level of the pit and provisions have been made to extend the skip deeper if needed. The railway consists of two parallel tracks of 90-pound rails laid on 14-foot wooden ties placed at 2½-foot intervals, with each fourth tie 18 feet long. Non-slip tie plates are placed between the rail and ties which are ballasted and secured with pins into the ground. The two skip cables are supported by rubber-lined rollers placed on 25-foot centers. Inspection of the track and rollers is facilitated by a walkway running along the side.

Two 25-ton skips weigh 39,490 pounds each and consist of a double-

LIBERTY PIT showing skip hoist installation on north side. The length of the incline is 1,215 feet with a vertical lift of 405 feet.



STEEL HEADFRAME at top of pit contains two 100-ton storage bins with a surge capacity of 180 tons. Flop gates direct ore into bins while two feeders load 75-ton railroad cars in approximately one minute.

wall welded body resting on a four-wheel open frame chassis. To provide cushioning the wheels are spring-mounted and the rear axle will pivot, giving three point suspension. Thus the skips can travel at high speed without danger of derailment. The body of each skip is suspended within the chassis by means of trunnions at approximately the center of gravity of the load so that dumping of the skip is merely a rocking action of the body within the chassis. At the headframe the skips are dumped by means of scrolls on dump plates above the storage bins. An automatic slow-down control serving the system allows the skip to enter the scrolls at a speed of only 190 feet per minute. The hoist pulls the skip through the scroll to tip the body, dump the load and stop. The two skips operate in counterbalance.

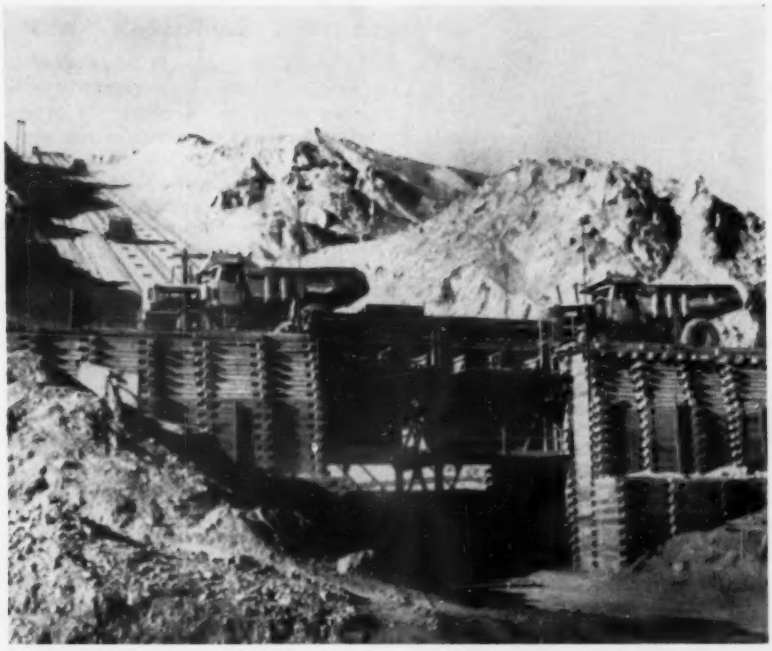
The steel headframe of the system is located on the edge of the pit on the 7,033 level. It contains two separate storage bins each with a level capacity of 100 tons and a surge capacity of 180 tons, and each serviced by a standard gauge railroad track for railway car loading. Each track is equipped with guard rails so truck loading can be accomplished on top of them. The skips dump directly into the storage bins. There are four 7-foot reciprocating plate feeders, two under each bin, that service the bins and feed the railway cars or trucks. The feeders are hydraulically operated from a special booth at the headframe, as are flop gates that direct the skip loads into the storage bin that is in use at the time of car or truck loading.

The loading structure at the bottom of the skip installation is of the drive-over type with two 25-ton surge bins. These bins are equipped at the top each with double bridge gates and at the bottom each with a skip loading gate. Both types of gates are hydraulically operated. The loading operator opens one of the two bridge gates after a truck has driven over it and the truck dumps directly into the surge bin. The operator then opens the unloading gate which loads the skip. After filling the skip he sends it on its way. This entire hoisting operation is semi-automatic with a control panel located in a special booth on the side of the loading structure.

Communications between the skip loading operator at the bottom and the car loading operator in the headframe at the top are maintained by means of an intercommunication system.

The hoist is a double drum cylindrical model with an expanding toggle type clutch coupling the two drums. Each drum is 11 feet in diameter with an 8-foot width, grooved for 1-7/8-inch hoisting cable. Each drum is mounted on a separate drum shaft, the drum shafts being connected by means of the toggle clutch located between the drums. The clutch housing supports one end of each drum shaft on anti-friction bearing. The other end of the drum shafts each extend into and are supported by a standard twin-pinion gear reducer on anti-friction bearings. The gear reducers are double reduction and have two input pinions coupled to direct current motors. The gear ratio is approximately 24 to 1. The drive proper is a variable voltage, direct current system employing four 300 horsepower motors in a single series loop with two 500 kilowatt generators. These generators are driven by a single 1,250 horsepower leading power factor synchronous motor. Power for this motor is received from one of four secondary feeders at the pit 2,500 KVA 2,300 volt substation.

Braking of the skips is accomplished automatically by two methods in two steps. Slow-down is accomplished by electrical regenerative braking, and stopping is accomplished when the skips have reached approximately 5 percent of full speed by means of electro-magnetic springset mechanical brakes acting on drums carried on the reducer side of each of the motor couplings. Each of the mechanical brakes affords 4,000 pounds torque through solenoids when the hoist is decelerated to approximately 5 percent of speed.



SKIP LOADING structure is drive-over type with two 25-ton surge bins. Operator directs dumping of trucks but skip loading is semi-automatic.

Semi-automatic control is one of the main features of the skip system. The skip loading operator at the bottom of the incline controls the movement and dumping of haulage trucks at the loading station with signal lights. The loading of the skip is hydraulically controlled and the hoisting and automatic dumping of the skips is done by the same man using push button controls.

The skips are currently served by seven 22-ton Euclid end-dump trucks that are loaded on the lower levels of the pit by four-yard electric shovels.

The maximum carrying capacity of the skip system is 1,120 tons per hour based on a 47 minute operating hour. The total cycle time is 65 seconds: 12 seconds for acceleration, 10 seconds for retarding and 7 seconds rest. The rope speed is 1,630 feet per minute.

At the headframe the bin level indicators at each bin automatically shut the hoist off when the bins are fully loaded. The car loader operator controls the storage bin flop gates and feeders by means of push button controls. Ore is loaded into the 75-ton railroad cars in a little over a minute for shipment to the Kennecott reduction plant at McGill, some 22 miles distant.

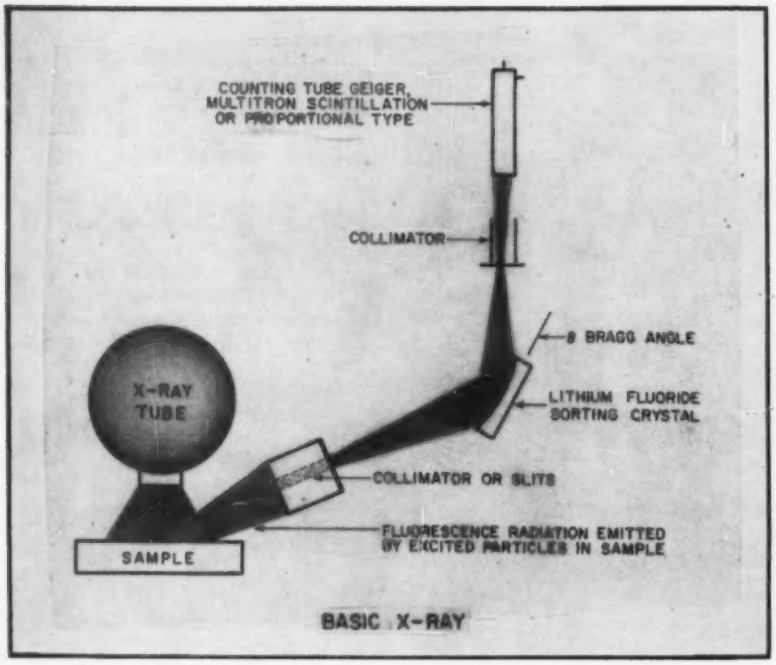
The operation of the skip installation at the Liberty Pit has been successful after normal start up adjustments. The advantages of the system include: (1) reduced stripping ratio required for pit expansion over haulage methods since only limited access and service roads are required in reaching final pit limits; (2) elimination of the need for maintaining benches for railroad tracks or haulage roads; (3) greater flexibility in mine planning; (4) lower pit equipment capital and maintenance costs; (5) minimizing ore car maintenance on the pit-reduction plant rail haul due to decreased loading damage as well as an improved load factor; and (6) greater productivity.

The skip installation and hoist were designed and fabricated by the National Iron Company of Duluth, Minnesota, who also erected the hoist house, headframe, and skip loading structure assisted by the Utah Crane & Rigging Company of Salt Lake City, Utah, and Burdick and Biale, contractors, Ely, Nevada. All electrical equipment was manufactured by Westinghouse Electric Corporation and installed by the Foley Electrical Company of Salt Lake City. Construction of the skip trackway, necessary cribbing for the approach to the skip loading structure, as well as service roads and track to the headframe, was performed by Kennecott Copper Corporation personnel. END

Skip Hoist
Statistics and Operating Data

Elevation loading station (top)	6,704 ft.
Elevation headframe (base)	7,033 ft.
Total hoisting distance	1,234 ft.
Slope of skip trackway	19° 04′
Total vertical rise	405 ft.
Weight of ore (wet)	50,000 lbs.
Weight of skip	39,490 lbs.
Weight of rope	5.6 lbs./ft.
Rope diameter	1⅞ in.
Drum diameter of hoist	11 ft. 0 in.
Hoist type—double cylindrical drum clutched	
Hoist drive—twin pinion, four 300-hp 1,150 rpm motors in a single series loop with two 500 kw generators, driven by one 1,250 hp leading power factor synchronous motor.	
Rope speed	1,630 fpm
Acceleration time	12 sec.
Retarding time	10 sec.
Rest time	7 sec.
Total cycle	65 sec.
Maximum capacity (47 min. operating hour)	1,120 wet tph.

TWO STEEL SKIPS are counterbalanced and speed 25 tons of low grade copper ore to the top of the Liberty Pit many times faster than previously done by truck.



How X-Ray Analysis Works

1. The pulp stream to be sampled is irradiated with high intensity primary x-rays which excite the atoms of the various elements in the sample.
2. The excited atoms emit secondary x-rays, or fluorescent radiation, at a wave length characteristic of the particular element—copper, iron, sulphur, silica, etc.
3. The secondary x-ray beam passes through a primary slit or collimator, and a selected portion of the radiation is caused to fall upon a lithium fluoride crystal.
4. This curved LiF sorting crystal disperses the beam and passes only the energy beam of interest—copper.
5. The sorted or diffracted beam enters a suitable Geiger tube detector where the fluorescent energy is measured.
6. The energy read-out is then reproduced on a strip chart as a continuous tracing.

Copper Assays Take Only Two Minutes at the Anaconda Concentrator

by John R. Bogert
Field Editor, MINING WORLD

The operators in the Anaconda copper concentrator in Montana have a useful tool for efficient control of their flotation process which means higher concentrate grades, better recovery, and reduced costs. This is the almost instantaneous assay results they now receive by an x-ray fluorescent spectrographic analysis system recently installed by Anaconda research engineers. This modern system monitors the pulp stream in the flotation circuit by the Quantrol x-ray method and records the assays on a circular chart meter. The time lapse from sample taking to assay result is just two minutes! Thus the Anaconda flotation man has a greater degree of metallurgical control over his flotation circuit than ever before.

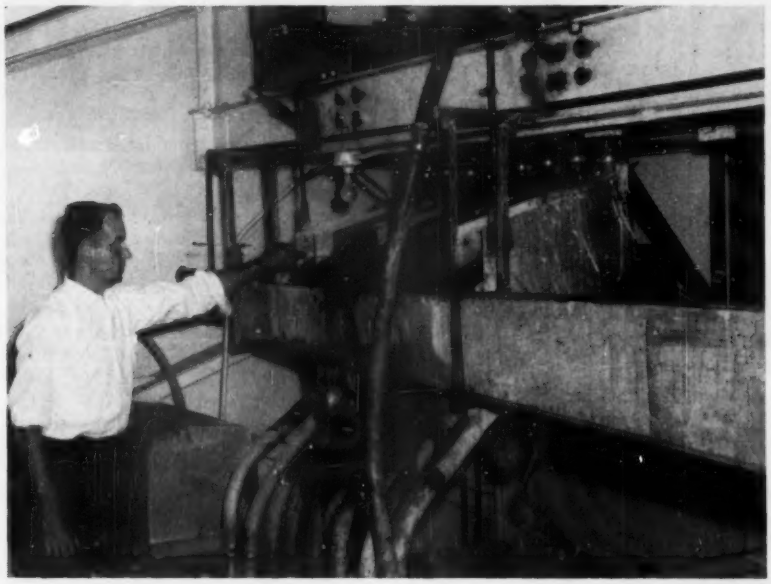
The Quantrol, made by the Applied Research Laboratories of Glendale, California, is the copper industry's first x-ray fluorescence analyzer to provide quantitative determinations directly on the production line for continuous stream control. The principle of operation is relatively simple. The pulp stream flows through a special sample holder with a "mylar" covering and is irradiated with high intensity x-rays, causing fluorescence radiation. The latter radiation passes through a primary slit to a curved lithium fluoride crystal which disperses the beam, and causes the selected element's wave length to impinge on a pair of Geiger counters. The energy read-out is then reproduced on a strip chart as a continuous tracing.

The system consists of three component parts: the spectrometer, power supply, and ratio (ARL patent) recording console. The spectrometer consists of a Machlett OEG-50, water cooled x-ray tube, and two spectrometer-detector channels. The power supply tank contains a full-wave rectified and filtered supply for the x-ray tube. This supply can deliver up to 60 kilovolts and 50 milliamperes of low ripple power to the x-ray tube. The ratio recording console compares the unknown element in the sample to an internal standard, and provides a permanent, direct-reading, inked record of comparison on a strip chart.

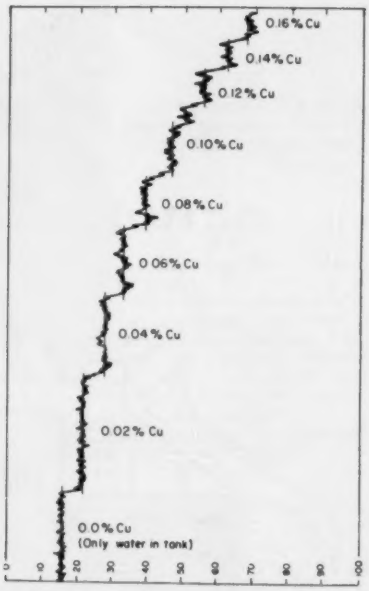
The Quantrol x-ray method proved quick and accurate in assaying a given sample of pulp from the mill. The problem that had to be licked by Anaconda research engineers was how to get a proper, representative sample to the x-ray machine efficiently and quickly so that assay results would be of value to the flotation operator. The problem was one of sample presentation. Samples taken by the usual collection methods were antiquated and impractical–like carrying airline passengers to a jet plane in a horse-drawn wagon. A fast assay result required a fast sample collection to make the whole system practical.

Long use of the familiar sample bucket and tedious preparation practices had narrowed thinking concerning sample taking. However, it was finally realized by Anaconda engineers that the pulp stream in the flotation circuit was the ultimate in samples. The prevailing turbulence guaranteed a random distribution of solid particles. Thus, monitoring this existing pulp by x-ray was the perfect solution. The surface of the sample in the special holder could be reproduced exactly by the x-ray unit, and the distribution of solids controlled by the irradiation of the primary x-ray beam.

The testing of this new idea was first tried in the laboratory. Various synthetic pulps were pumped through a plastic sample cell in the excitation chamber of an x-ray spectrograph. Peak intensity levels were charted for a series of pulps containing increasing copper concentrations starting with only water and barren quartz.



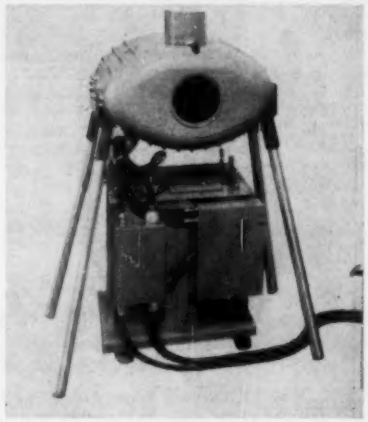
SAMPLE CUTTER and vibrating screen for removing wood splinters from the pulp sample stream are inspected by research engineer Bill Lucy.



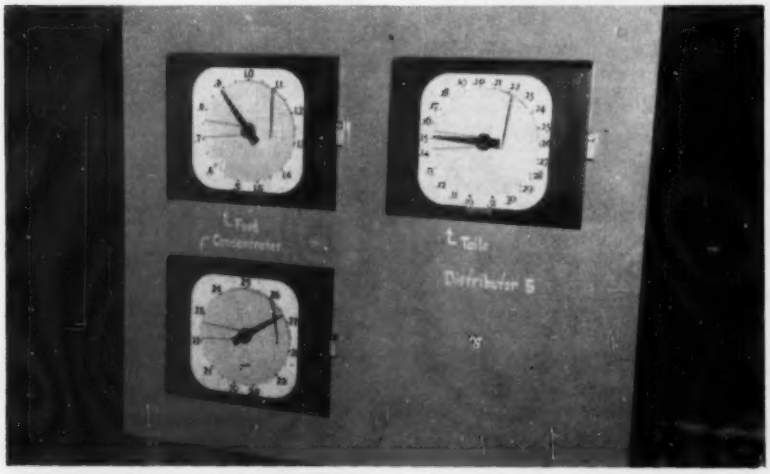
INTENSITY LEVELS were charted for pulps with increasing Cu concentrations.

Continued experimentation, however, showed that high quality assays required taking into account the pulp density variations. This is because the x-ray sees only the surface layer of the pulp, and the number of copper particles in that surface layer vary with the percent solids. Thus, to obtain a "true" assay it is necessary to determine the percent solids in the pulp and make a proper correction. This was accomplished by use of an AccuRay density gauge to determine the percent solids, and a special "correction" console developed by Anaconda engineers.

The first in-plant test of the new equipment was made in late 1959. It was soon seen that large scale collecting and transporting of small sample streams of pulp from the concentrator presented many problems not encountered in the small scale tests conducted in the laboratory. In the research lab samples were fed to the x-ray machine by gravity feed over a very short distance. The synthetic pulps contained no chemical contaminants or physical factors that affected their performance in the x-ray equipment. On the larger scale, though, the pulp from the concentrator circuit contained a lot of wood fibers, which jammed in the hoses leading to the x-ray cell. Flotation reagents in the pulp caused air bubbles to be included, causing a froth flotation action which, in turn, caused a concentration of copper minerals. Certain plastic materials in the hose



SPECTROMETER containing x-ray tube and two spectrometer-detector channels.



MILL OPERATOR sees his assays on this board within two minutes of sample collection and can make necessary changes in his flotation circuit.

SPECIAL RATIO recording console provides energy read-out on strip chart.

conduits attracted oily type flotation reagents with resultant buildup of fine air bubbles which again caused accidental flotation. The problems were numerous.

Finally, after experimentation and adjustments, a dependable technique was established that continually yielded reliable assay information.

A sampler cuts the pulp in the mill, it passes over a vibrating screen which removes the wood fibers, and then flows at negligible head through small diameter rubber tubing to the sample holder in the sample cell of the x-ray. The total time lapse from collection of the sample to assay result on the chart recorder is just two minutes. Armed with this practically instantaneous assay information, the operator is then able to exercise greater metallurgical control over his section of the concentrator's flotation circuit.

Quantrol Operating Conditions

X-ray tube target material	High purity platinum
Target excitation for bulk and scavenger tailings and ore	40 KV @ 30 MA
Target excitation for final concentrates	20 KV @ 10 MA
Analyze channel	Cu K-Alpha (2nd order) @ 1.542 A°
Monitor channel	P L-Beta (2nd order) @ 1.100 A°
Primary slit width	0.010-inch both channels
Secondary slit width	0.020-inch both channels
Diffraction crystal	LiF @ 4-inch radius, both channels
Detectors	Geiger type, paired
Channel voltage, analyze	1,290
Channel voltage, monitor	1,308
Sensitivity	433
Zero depress	167
Time constant	30 or 60 seconds to average random "noise"
Ratio amplifier	10 (analyze signal must exceed monitor signal)
Recorder	L & N Speedomax G (modified 0-50 MV)

Having such current assay information, the flotation operator can now maintain closer metallurgical control over his individual flotation sections. By receiving 2-minute assays on bulk tailing, scavenger tailing, and final concentrates, he knows the grade and recovery of his operations. Quick assays on bulk feed and bulk concentrate give him the grade of the input to two of his major circuits.

The benefits of this fast, flexible x-ray assay technique are reflected in higher concentrate grades, improved recoveries, and cheaper assaying when compared with the conventional assaying methods. END

WHAT'S GOING ON in mining

Arizona

Winner of a guessing contest sponsored the **Crucible Steel Company of America** at the American Mining Congress in Las Vegas in October was Mrs. George Colgate, wife of George Colgate, design engineer for **Miami Copper Company,** Miami, Arizona. Mrs. Colgate guessed that it would take 71,000 pounds to compress a heavy industrial spring solid; according to tests, it would have taken 71,200 pounds. A prize of three pieces of luggage was presented to Mrs. Colgate by R. L. Stark, manager of Crucible's Denver branch.

In order to carry on second level development at its **San Manuel** subsidiary, and to replenish working capital for the operation, **Magma Copper Company** is deferring to maturity date six payments of $1,250,000 each on a government loan. Maturity date of the $72,984,000 loan is February 1973.

The Table Mountain group of 10 unpatented mining claims has been optioned by **Duval Sulphur and Potash Company,** of Tucson, Arizona. The property is located in the Saddle Mountain district of Pinal County, about 12 miles north of Mammoth. Two men are employed in preliminary exploration, consisting of geological field work, mapping and sampling old tunnels, etc., and some road building. Exploration by diamond drill will be undertaken shortly. The mine is owned by Mrs. Mattie Young and her daughter. Principal workings are two 450-foot adits.

A crew of about 24 men is being employed by **Fisher Construction Company** in construction of the new leaching plant for **Bagdad Copper Company,** Bagdad, Arizona. Ground was broken for the plant on July 20 and by the first of September forms were being placed for the 11 precipitation tanks and some cement was being poured in the completed forms. Also, foundations for the two acid converter tanks were poured and other foundations were being set. The Fisher firm expects to employ a maximum crew of 70 to 75 men before the plant is completed in March or April of next year. Bagdad continues to mine and mill at a normal rate, employing a regular crew of about 350 men.

A 400 percent expansion in production capacity has been underway recently at the Houck, Arizona, plant of **Arizona Silica Sand Company** of Phoenix where the product is a sand used by the oil industry in cracking oil-bearing rock to permit better oil drainage into the drilled wells. The unique product, a sand with grains that are nearly spherical, is screened into uniform sizes after preliminary washing and drying. The increased plant capacity requires much more water than before, but so far the Houck wells of the Santa Fe Railway have been able to supply the demand. The steel tanks at the Houck railway station, formerly used for water, are now employed as sand bins. The company is currently shipping about 100 tons of sand daily.

A group of patented mining claims in the Ajo district of Arizona has been purchased by **Phelps Dodge Corporation** from the **New Little Ajo Mining Company.** The claims are known as Firefly and Firefly Nos. 1 and 2. A sales value of $186,000 was indicated by revenue stamps on the mining deed filed in the Pima County recorder's office.

Metate Asbestos Corporation, Globe, Arizona, has developed both a domestic and foreign market for its filter grade (Number 3) chrysotile asbestos with two carloads per month going to each. In addition, a substantial tonnage of lower grade material is being shipped to Hermosillo, Sonora, Mexico, for use in roofing, siding, and tiling. Metate's new mill is working two shifts daily, the product classifying principally into four grades, Numbers 3, 6, 7 and 7a. Jack Neal is general manager.

Mrs. Mattie Young, Mammoth, Arizona, has leased her **Blue Bird** mine to A. H. Ellett and Byron Young, of Phoenix. The property is located in the Copper Creek district. The lessees propose to work the old mine dumps containing copper, silver, gold and lead.

California

Recent assay reports by **Herr Laboratory** seem to confirm the presence of phenacite, the richest of beryllium ores, at the Lone Pine, California, property of **White Caps Gold Mining Company.** Five tests of selected ore reportedly showed 17.45 percent, 16.05, 4.85, 11.00 and 14.20 percent BeO. According to Hugh F. Cameron, White Caps superintendent, an intensive drilling program has begun at the property where early samples averaged 0.42 perecnt BeO.

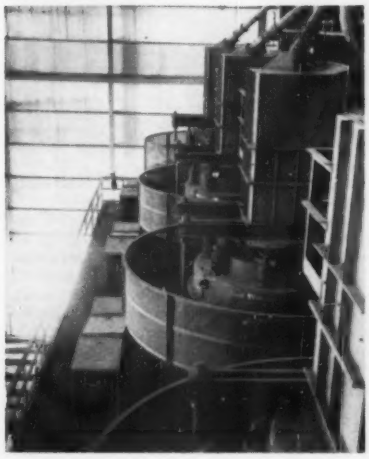
Metallurgists of **Stauffer-Temescal Company** of Richmond, California, have perfected methods for reducing grain size in cast tungsten and molybdenum ingot to substantially increase the ductility and workability of these two metals. Strength characteristics are not impaired by the technique which uses a combination of electron-beam processing and critical composition control. Similar techniques have been successfully applied to the firm's range of other electron-beam processed alloys, including those of columbium and tantalum-tungsten.

Continued encouraging results are reported by **Siskon Corporation** from its open pit gold mine at Happy Camp in Siskiyou County, California. Production of gold and silver at the mine has exceeded $3,000,000 since milling operations began in 1953.

Nevada

Carson Land & Development Company of Modesto, California, has purchased the old **Tybo** lead-zinc mine in Nye County, Nevada, and will start an exploration program. The mine, first discovered in the 1860's, has been developed to a depth of

Kaiser Steel's New 'Advance Design' Fine Ore Crushing Plant



The new secondary crushing plant recently placed in operation at the Eagle Mountain, California, iron mine of Kaiser Steel Corporation is probably the most modern in the world. Main feature of its advanced design is the unique placement of the six cone crushers on 28-foot-high reinforced concrete foundations over the eight vibrating screens at the bottom of the plant. The picture shows how four 7-foot short head Symons crushers are mounted near the top of the plant. This arrangement eliminates the usual reclaim tunnels of other crushing plants, and prevents product size ore from recirculating, by conveyor, to the short head crusher feed bin, with a resultant saving in construction and operating costs.

Designed capacity calls for crushing of 1,500 tons per hour of 7-inch feed to ¾-inch top size. Reclaimed ore from primary crusher stockpile is discharged to two 6 by 16-foot scalping screens which bypass undersize and feed plus-3-inch ore to two-foot Symons standard cone crushers. Crusher product and bypassed ore then feed four 6 by 16-foot product screens which pass minus-¾-inch ore to the product conveyor, and oversize to the recirculating conveyor system.

The recirculating conveyor discharges into a 1,200-ton surge bin which feeds the four short heads in parallel. Crusher undersize drops to a 6 by 16-foot vibrating screen. Product size ore from these screens drops to the product conveyor, and oversize reports to the same recirculating system receiving ore from the standard crusher circuit, thus putting the short head crushers in closed circuit.

The new secondary crushing plant as well as the new 3,000-ton-per-hour 60-inch Nordberg primary crushing plant were designed and built by Kaiser Engineers as part of the expanded Eagle Mountain stripping, mining, and beneficiation program.

WHAT'S GOING ON...
SOUTHWEST

1,310 feet and the water level is said to be at about the 300-foot level. Production at the mine between 1867 and 1941 is estimated at some $9,500,000. Portions of the property have been operated recently under lease. The sale to the Carson firm by Herman Budelman, Fred Ninnis, and Phillip R. Bradley, Jr., included 10 patented mining claims and two mill sites located about 60 miles northeast of Tonopah.

Anaconda Company has started construction of a two-section flotation mill to supplement present oxide leaching facilities at its Weed Heights, Nevada, copper operation. The $6,000,000 addition will enable the company to treat the considerable amount of sulphide ore which is being exposed at the Weed Heights open pit. The present mill will beneficiate only acid-soluble copper ore. Crushing equipment now in use will be able to handle both types of ore. The new mill will incorporate fine-grinding and flotation equipment, as well as filtering and drying equipment, and storage areas for coarse and fine ore. The new mill, scheduled for completion about a year from now, will have a capacity of 5,000 tons daily, operating on a seven-day weekly basis.

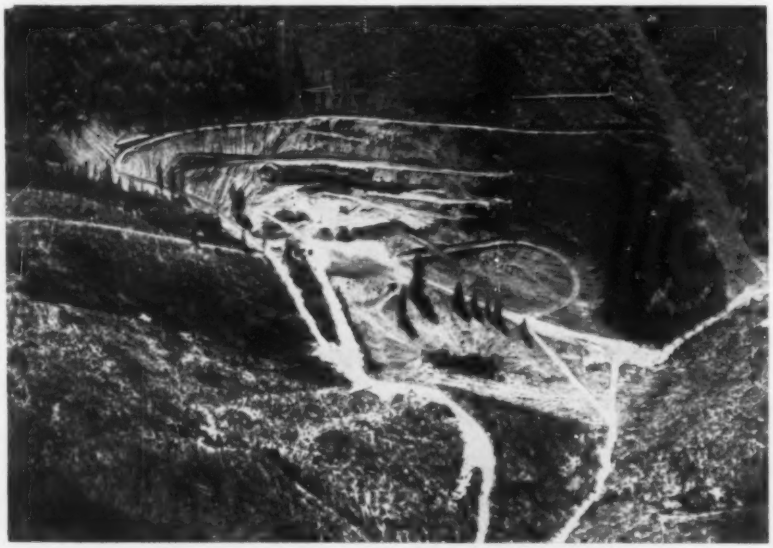
North American Development Company has started milling on the **Governor** group of cinnabar claims located 52 miles northeast of Battle Mountain, Nevada. Mining and exploration operations have been under way since January, pending completion of an externally-fired mercury reduction furnace. This was the former property of **Governor Mercury Mines.**

A surface drilling program is being carried out by **Utex Exploration Company,** lessee of the **Kansas** mine, 68 miles northeast of Ely, Nevada. Robert K. Wyant is the geologist in the exploration for copper, iron, and gold.

Gold Eagle Mines, Inc. of Longview, Washington, is sinking a shaft at its **Sally Louise** mine in Nye County, Nevada. A contract with **Mines Contracting, Inc.,** calls for deepening the shaft from 170 to 250 feet, plus 350 feet of drift and crosscut from the 250 level. Gold Eagle Mines recently received an OME exploration contract.

New Mexico

International Uranium Corporation, operator of a mine and mill 25 miles southeast of Albuquerque, New Mexico, has merged into **Western Smelting and Refining Corporation,** with headquarters in Albuquerque. According to Clifford Taylor, president and general manager, the merger provides a new corporate structure for expansion in mining, smelting, and refining of gold, silver, copper, and various metals of the platinum group, besides deleting "uranium" from the firm name. Assets with the merger include mines, a 100-ton-per day mill, office, crushing plant and buildings and equipment at the mine site. The company expects to move to a new smelting and refining plant south of Albuquerque early next year.



S Bar S Mine Produces Sulphur For Soil Conditioning

An aerial view shows the new S Bar S open pit sulphur mine in Lake County, California, which reportedly contains reserves of some 15,000,000 tons averaging 15 percent sulphur. The American Mineral Resources Development Company, owner of the 140-acre property, is currently mining with a front-end loader and selling a 13 percent sulphur product to local farmers who have a sulphur deficiency in their soils. Future plans are to provide raw sulphur for the chemical and sulphuric acid industries in western United States. The deposit consists of sulphur disseminated in a highly altered body of tuff containing fragments of obsidian and pumice. It covers an area of 37 acres. The origin of the elemental sulphur is sulphur dioxide vapors rising through volcanic ash from depth. Development consists of two 60-foot adits, three six-inch rotary drill holes, and the open pit where approximately 25,000 tons of sulphur bearing material have been removed. The deepest drill hole bottomed at 177 feet in 22.5 percent sulphur and averaged 18.26 percent through 127 feet of tuff.

Iron Mining Symposium Set For Duluth January 9-11

Factors affecting the future of Lake Superior iron ores will be the subject of emphasis January 9, 10, and 11 during the Twenty-Second Annual Mining Symposium in Duluth, Minnesota. The session under the sponsorship of the University of Minnesota's School of Mines and Metallurgy and Center for Continuation Study is being held in conjunction with the annual meeting of the Minnesota Chapter, AIME, January 9.

Robert J. Linney, president of Reserve Mining Company, Silver Bay, Minnesota, will give the keynote address for the AIME meeting, on Monday, January 9. His topic is "What Are We Doing and What Must Be Done to Meet Competition?" Other subjects for discussion Monday include the Lake Superior region's future in non-metallic taconites and basic research trends in mining and in mineral beneficiation.

During the initial symposium session Tuesday morning the impact of labor efficiency and costs will be discussed by Hugh Leach of Cleveland Cliffs Iron Company and others. On Wednesday, when the symposium program closes at noon, one of the speakers will be Christian Beukema, president, Oliver Mining Company.

Hanna Starts Stripping At Mississippi Mine on Mesabi

The M. A. Hanna Company is reopening the Mississippi No. 1, a state mine located near Kewatin, Minnesota, and adjacent to the Sargent mine where Hanna is carrying out a stripping operation. The new lease from the state of Minnesota for operation of the Mississippi property was given because of the marginal nature of the small tonnage of ore remaining on the property.

The Mississippi, when originally leased in 1899, had reserves of about 4,000,000 tons of iron ore. Of this, all has been mined and shipped except for a reserve containing about 447,000 tons of iron-bearing material. Approximately 18,000 tons of this is of direct-shipping grade, but the balance requires concentration to obtain a commercial reserve of about 200,000 tons.

Hanna has a heavy media concentrating plant in the vicinity to handle the Mississippi's marginal material and has begun stripping of surface and rock at the mine. The new lease will permit Hanna's development work at the Sargent mine to continue.

Central

In the joint exploration program of **American Zinc, Lead and Smelting Company** with **Granite City Steel Company** in the Bourbon, Missouri, area, continued favorable results are being obtained by three diamond drills. All holes drilled in the area since August, 1959, have indicated iron ore. Drilling will continue on the present basis.

St. Joseph Lead Company is closing its **Mine No. 9** in southeastern Missouri which includes old **Federal 9** and **10,** the old **Tetley** mine, and the **Columbia.** Center of operations for these mines is what was once known as Shaft No. 13. Most of the miners affected by the closing will be employed at the new **Viburnum** mine or in other St. Joe projects. At the company's **Federal** mill the crushing plant is to operate two shifts instead of three, working day and night shifts along with mine workers, which will provide enough ore so that the mill itself can operate three shifts.

The Missouri state geological survey is undertaking an aeromagnetic survey of an area covering some 3,700 square miles. Preliminary contoured aeromagnetic prints of the Boss, Corridon, Edgehill, and Lesterville Quadrangles are now available at a cost of 30 cents each. Further information is available from the State of Missouri Division of Geological Survey and Water Resources, P. O. Box 250, Buehler Building, Rolla, Missouri.

At the new Viburnum, Missouri, project of **St. Joseph Lead Company,** Shaft No. 27 in Crawford County and No. 28 in Iron County, where the mill is located, are now in production, with No. 27 producing about 1,900 tons of ore daily. The crushing plant handles 450 tons an hour and the mill puts through 6,000 tons daily from the two shaft operations. The Washington county shaft is not yet in production. At the new mill, automation has made it possible to use only 12 men, plus repair and clean-up crews, for 24-hour operation.

Eastern

The check diamond drilling program which **Tri-State Zinc, Inc.** is carrying out in the West New Market, Tennessee area, to check ore reserves will probably be completed early in 1961. The project is a joint venture with **American Zinc, Lead and Smelting Company** which controls the property. (See MINING WORLD, July 1960, page 57.)

Construction of a phosphate rock calcining plant that will further diversify its operations in the Bartow, Florida, area, has been started by **International Minerals & Chemical Corporation.** The $1,000,000 plant, scheduled for completion in mid-February, will adjoin existing drying, grinding, and shipping facilities of IMC at Noralyn. The plant's calcining kiln is to be 11 feet in diameter and 230 feet long, with an 80-foot cooler that is nine feet in diameter. While initial production will be from IMC's phosphate concentrates, pebble rock will be used later next year after wet storage facilities at Noralyn are enlarged. The product will be used in making high-grade phosphate fertilizer solutions and other phosphate chemicals.

The **East Meyer** barite mine in the Del Rio barite district of Cocke County, Tennessee was put into production this fall. Initial production is one railroad car per day of chemical grade barite (97 percent $BaSO_4$). Ore reserves in the vein-type deposits were determined by diamond drilling.

Tennessee Copper Company has rebuilt its liquid sulphur dioxide plant at Copperhill, Tennessee, which was destroyed by fire in September. Reconstruction of the plant, which was built in 1949, began within three weeks of the fire. Tennessee Copper mines 1,000,000 tons of massive sulphide ore annually.

A new ore concentrator that will reduce ore-handling costs and increase iron content of pellets will be built by **Bethlehem Cornwall Corporation** adjacent to its **Cornwall** mine in Pennsylvania. The new concentrator and pelletizing facilities will replace the 60-year-old plant at Lebanon. Raw materials research facilities, however, will remain at Lebanon. Construction at Cornwall will begin sometime in 1962.

A tour conducted by **American Cyanamid Company** at its Brewster, Florida, phosphate plant recently provided the public with an opportunity to inspect pollution control equipment which reduces fluorine fumes from the triple super phosphate operation. The system includes a new $500,000 chain mill where giant fans suck off escaping fluorine gas and blow it into scrubbers that are four stories high. Water sprayed into the scrubbers absorbs the gas and carries it to a disposal pond. Other points where the fluorine is drawn off are at the tanks, at a cone mixer, and in the curing building. When the air pollution control equipment is completed by an installation of dust collectors next year, the company's expenditures on pollution control will total more than $2,000,000. American Cyanamid is currently expanding its triple superphosphate operation.

Southeast Section of AIME Meets in Birmingham

A featured speaker at the recent annual meeting of the Southeast Section, AIME, was Dr. Frank A. Rose, president of the University of Alabama, shown above as he addressed more than 200 engineers and their wives from Alabama, Georgia, and Tennessee. The two-day session at the Dinkler-Tutwiler Hotel in Birmingham, Alabama, was opened by Eugene P. Reed of United States Steel, Section chairman. The first day's program featured technical sessions, including a symposium on automation that covered use of industrial television in underground mining.

WHAT'S GOING ON...

CENTRAL AND EASTERN

The titanium sponge plant of **Cramet, Inc.** in Chattanooga, Tennessee, has been sold by degrees by the General Services Administration. Previous attempts to sell the plant as a whole had been unsuccessful. The plant, financed largely by the government, operated for only a year at an estimated cost to the government of $65,000,000. It occupied a 127-acre site and included 17 buildings.

Capital expenditures of **Aluminum Company of America** will hit $85,000,000, up from $55,000,000 last year, according to Lawrence Litchfield, president. This is in spite of the fact that the expected 10 to 15 percent gain in total aluminum shipments failed to materialize.

Major part of a $60,000,000 expansion program planned by **Armour Agricultural Chemical Company** will be construction of a new phosphate processing plant at Fort Meade, Florida. The plant will extract and process phosphate rock, produce phosphoric acid and triple superphosphate, and also manufacture sulphuric acid. It will be considerably larger than Armour's present plant at Barstow, Florida. The Fort Meade plant, as well as a nitrogen processing unit at Sheffield, Alabama, will be started immediately for operation in 1962. Armour also plans several other new fertilizer plants in the rural Midwest and a modernization program for existing units.

Iron Ranges

Complete ownership of **Pacific Isle Mining Company** of Hibbing, Minnesota, has been acquired by **Inland Steel Company** of Chicago, Illinois, which previously owned it jointly with **Pittsburgh-Pacific Company.** Through Pacific Isle, which will be a wholly-owned subsidiary, Inland will operate the open-pit **Iroquois** mine at Mountain Iron, Minnesota. Other Mesabi range operations of Pacific Isle will be managed by Inland's raw material department. Pacific Isle, one of Minnesota's largest independent mining firms, was founded in 1946. Inland acquired its first holdings in the firm in 1951 and became a major customer for Pacific Isle's iron ore. Pacific Isle has also sold to Pittsburgh-Pacific Company its interest in **Coons-Pacific Company,** which operates a beneficiating plant in Eveleth, Minnesota.

Lake Superior iron ore shipments from lake ports up to November 1 totalled 64,028,288 tons, compared with 34,475,506 tons on the same date in 1959. **Erie Mining Company,** shipping through Taconite Harbor, had the greatest tonnage—5,400,295—while **Reserve Mining Company,** through Silver Bay, shipped 4,756,354 tons. Comparative figures for 1959 up to November 1 were 2,370,982 for Erie and 2,781,178 for Reserve. An early shutdown, possibly the earliest of the postwar period, is seen for the Great Lakes shipping season this year. Nearly half the 230 ships in the fleet were idled early in November, with the rest expected to follow suit shortly. Inventories are high, with tonnage of 74,130,000 on October 1 compared with 60,553,000 on the same date in 1959; 68,012,000 in 1958, and 61,844,000 tons in 1957.

An above-ground screening plan is being built at the **Tobin Mine** of **Republic Steel Company** in Crystal Falls, Michigan, as part of an extensive modernization program. The installation includes two 70-ton-capacity bins to handle ore of different grade sizes, plus a third that receives crushed rock from underground mine development. The bins are built as an integral part of the headframe and suspended from the structure immediately under the crusher.

Completion of the mine shaft and auxiliary facilities at the new Southwest ore body of **Copper Range Company** in Michigan's Upper Peninsula is expected sooner than originally planned. The ore body is located about two miles southwest of the firm's **White Pine** mine. Development and mining of the ore body will require modification of the company's mill and smelter to handle increased production and higher grade of ore.

Crucible Steel Company of America has sold its half-interest in the **Snyder Mining Company** to **Shenango Furnace Company,** co-owner. Snyder, which has produced about 700,000 tons of direct shipping ore a year from its Minnesota mines during the last three years, has been Crucible's largest source of ore for its blast furnaces at Midland, Pennsylvania. Crucible's sale of Snyder is seen as a trend toward greater use of upgraded, higher content ore, as well as the greater availability of sintered ore and pellets on an open market basis, stemming mainly from opening of new mines in Canada and other sources.

Utah

Texas Gulf to Proceed With Big Utah Potash Project

Texas Gulf Sulphur Company has decided to proceed with development of the Moab, Utah, potash reserves and expects to market potash from the deposit by 1962.

The $25,000,000 project will include construction of a highly automated processing mill with an initial capacity of over 1,000,000 tons of potash yearly. This tonnage may be increased another 500,000 by the end of 1963.

Texas Gulf is acquiring, under option, several thousand acres of land owned by Delhi-Taylor Corporation which will retain an interest in the potash properties and receive advance payment of $4,500,000 during a period of four and a half years. Delhi-Taylor began its exploration of the deposit at Cane Creek on the San Juan-Grand County line in 1955.

The latest type of continuous mining techniques will be used in mining the extensive deposit. Texas Gulf is presently drilling a 2,700-foot pilot hole at the northern end of the Cane Creek property, just north of the county line in Section 24, and northeast of previous drilling. A 7-⅞ inch core will be recovered to a depth of 2,700 feet for examination and evaluation of rock characteristics and structure to ascertain feasibility of sinking the 20-foot-diameter main shaft at that site. However, the company will continue drilling to 3,500 feet to permit study of the formation below the ore horizon.

By drilling the pilot hole at the projected shaft site on the extreme end of the known ore body, it will be possible to meet pillar requirements around the shaft, yet eliminate the chance of leaving a large block of ore unmined.

Production is scheduled to start this month at the phosphate mine-mill complex of **San Francisco Chemical Company** 12 miles north of Vernal, Utah. The 600,000-ton-yearly plant will ship its phosphate concentrate to the Garfield, Utah, plant of **Western Phosphates Inc.** for manufacture into triple superphosphate fertilizer. According to D. L. King, president and general manager, the deposit can be open-pitted for 100 years before underground methods are needed. (See MINING WORLD, May 1960, page 85.)

The **Office of Minerals Exploration,** Department of the Interior, recently approved minerals exploration contracts to three Utah firms. Contracts for lead and zinc were issued to the **United Park City Mines Company** for exploration in Salt Lake, Summitt, and Wasatch Counties, and to **Keystone Mining Company** for Summitt County. **Brennan Hannifin** was issued a contract for zinc, lead, and copper exploration in Juab County. Government participation amounted to half the estimated cost in each instance.

An option on the old **Scranton** lead-zinc mine a few miles north of Eureka, Utah, has been taken by **The Anaconda Company** from **McFarland and Hullinger,** Utah and Arizona mine contractors. Some 21 claims are covered in the property which Anaconda will map and sample. Some drilling may also be undertaken to extend ore shoots developed by previous operators. Approximately 62,000 tons of sorted lead-zinc ores were shipped from the mine up to 1955. Earlier records indicate the mine produced more than $1,000,000 in silver-lead-zinc ores previous to 1915. Ores are entirely oxidized and occur as replacements in limestone near the Scranton fault fissure.

An OME contract for $75,440 has been received by **Vitro Minerals Corporation** of Salt Lake City, Utah, to explore for beryllium in Juab, Utah.

Geology of the uranium deposits in the Monument Valley area of Utah is the subject of a report, Bulletin 1087-D, available from the **United States Geological Survey.** In addition to detailed information on the uranium ore bodies and on prospecting for new ore deposits, the bulletin includes a geologic map that shows the location of all known ore bodies in that area of San Juan County.

Colorado

Diamond drilling by **Denver-Golden Oil & Uranium Company** at both the Burbank Tunnel and at the upper operation near Clear Lake in San Juan County, Colorado, is producing excellent results. Work will continue as long as weather permits in preparation for greatly expanded activity next summer. The vein at Clear Lake contains lead and

silver with some gold values. Core assays at Burbank also indicate good values in base metals and gold.

A declining ore and concentrate supply will result in suspension of operations at the Leadville, Colorado, smelter of **American Smelting and Refining Company.** The firm will continue an active ore buying program in Colorado, but the ore and concentrates will go to the company's plant at El Paso, Texas. The Leadville plant has been operating since 1879 and was taken over by ASARCO in 1899.

Four Corners Oil & Minerals Company of Denver, Colorado, had greater gross sales of uranium during the first eight months of 1960 than for the same period last year when properties were operated by **Four Corners Uranium Corporation,** before its merger with **Four Corners Oil & Gas Company** into the present firm. **Union Carbide Nuclear Company** was given an option to lease 198 Four Corners' claims in the **Bull Canyon,** Colorado, area, doing assessment work for 1960 as part of the agreement. Two test holes found ore in locations not drilled previously. Production at the **Lion Creek,** Colorado, mine halted when known reserves were mined, but during assessment work by new lessees, new reserves were located by drilling. Two channels, each more than 600 feet long, will be put in production soon. At Uravan, Colorado, Four Corners obtained small production on claims not mined previously. The firm expects an increase this year because of additional discoveries not yet in production.

Beaver Mesa Uranium, Inc. of Grand Junction, Colorado is mining an average of 5,000 tons of ore per month from its property on Beaver Mesa near the Colorado-Utah border. The company is carrving out an underground diamond drilling program to maintain and, if possible, increase reserves and production since there is now a greater demand for the type of ore the mine produces than there has been during the last two years. Total ore production by the company for the fiscal years 1956 through 1960 has been 279,292 tons, assaying 0.28 percent U_3O_8, and 1.01 percent V_2O_5. This year's output of 66,558 tons for the year ended August 31 was a decrease from last year, although the grade was higher.

Wyoming

Plans for a second large gypsum plant in the Big Horn basin area of Wyoming received impetus when directors of **Crystal Creek Gypsum Company** agreed to transfer 67 gypsum claims to a corporation which will be formed. The claims along the Big Horn River are located near Himes, about 13 miles southeast of Lovell. The new corporation is to develop the claims and build a $5,000,000 plant employing 60 persons to manufacture a finished gypsum product. The proposed plant site is about one-half mile from the claims. Recently the **Big Horn Basin Gypsum Company** began construction of a $3,000,000 gypsum board plant near Cody.

Northwest Mining Association Meets Dec. 2-3 in Spokane

Nearly 40 speakers, a record number, will appear on the program of the Northwest Mining Association's 66th annual convention December 2-3 in Spokane, Washington. Officials expect a record attendance of more than 1,000 for the sessions in the Davenport Hotel.

For the first time, an industrial engineering session is scheduled. It will concentrate on the adoption of modern controls and techniques to the business of mining.

Speakers and their topics will include: Marling J. Ankeny, Washington, D.C., director of the U.S. Bureau of Mines, "Experimental Programs of the USBM, With Emphasis on Underground Hydraulic Mining;" Clark L. Wilson, Washington, D.C., chairman, Emergency Lead-Zinc Committee, "Work of the Committee in Washington and Geneva;" Dr. Elgin Groseclose, Washington, D.C., economic consultant, "The Place of Gold in the World's Economy;"

George O. Argall Jr., San Francisco, editor of MINING WORLD and WORLD MINING, "The Impact of Foreign Mining on United States Producers;" Edward R. Borcherdt, San Francisco, director of mining research, The Anaconda Company, "Some Revolutionary Developments in Underground Mining;" Elmer A. Jones, Bonne Terre, Missouri, division manager, St. Joseph Lead Company, "St. Joseph Lead's New Viburnum, Missouri, Lead Discovery;" Norman Moberg, Duluth, Minnesota, director of mineral development, Oliver Iron Mining Division, United States Steel Company, "Taconite Mining in the Lake Superior Area;" and John A. Laberee, Palo Alto, California, manager, E. I. du Pont de Nemours Company's Pacific Coast Extension Division, "The Menace of the Misinformed."

John W. Currie is general chairman of the 1960 convention. A trustee of the association, he is resident manager of American Zinc, Lead and Smelting Company's Spokane office. E. K. Barnes, Spokane, association president, and E. C. Stephens and Frank N. Marr, past presidents, head the steering committee.

Other committee chairmen are: Stanley W. McDougall, Kellogg, Idaho, finance; James Quinlan, Spokane, exhibits; Hamilton Owen, Spokane, registration; R. F. Tharp, Spokane, arrangements; A. E. Weissenborn, Spokane, program; Mrs. Maury Fetzer, ladies' arrangements.

Alaska

Nomura Mining Company Ltd. of Tokyo is reportedly negotiating with **DeCoursey-Brewis Ltd.** to purchase mercury and antimony soot from that company's **Red Devil** mine in Alaska. The Japanese firm is also interested in buying a cinnabar prospect on DeCoursey Mountain where exploration and development would be undertaken next year if negotiations are completed and approved by Nomura and the Japanese government. The antimony soot, an important byproduct of Red Devil operations, is currently priced so low it is uneconomic to ship from Alaska. Nomura intends to do initial furnacing at the mine and ship soot aboard ships that carry pulp from Alaska to Japan.

A vein of gold-bearing ore being developed at the **Mikado** mine, Lake Chandalar district, Alaska, had been opened for more than 60 feet at last report. Width has ranged from six inches to four feet. Frank E. Birch, Spokane, Washington, mining engineer, is in charge of the work for **Little Squaw Mining Company**, jointly owned by **Grandview Mines, Inc.**, and **Metaline Mining and Leasing Company** of Spokane.

Clayloon Lead-Zinc Concentrator in Washington

This lead-zinc gravity-type concentrator has been constructed by Clayloon Uranium Company at Leadpoint, Washington, to improve recovery and make a shipping-grade concentrate from ore mined at its nearby Lead Trust and Lead King mines on Gladstone Mountain. From left to right in the picture are the concentrate bin, jig, fine ore hopper, conveyor belt, roll crusher, secondary crusher, primary crusher, and coarse ore hopper. The plant will be enclosed for winter operations. Testing at the mill began in mid-August. Ore is trucked to the mill from stockpiles built by open-pit mining. Clayloon leased the property in 1959, uncovered a wide vein of lead ore with a bulldozer, and drilled 14,000 feet of test holes up to 136 feet deep. Company holdings in the area now total 54½ claims.

Idaho

Nuclear Fuels & Rare Metals Corporation, Inc., has started trucking thorite ore from Patee Creek to its new mill near North Fork in Lemhi County, Idaho. The mill is now in operation and a considerable amount of experimental work and testing is being done by the **Larsen Industries** under the direction of Paul B. Cardon, vice president.

Idaho Goldfields, Inc., is planning to sink a winze on a vein of lead-silver-zinc ore found in the wall of an old tunnel at its property in Fourth of July Canyon east of Coeur d'Alene, Kootenai County, Idaho. The vein dips 45°. L. A. Thompson of Spokane, Washington is company president.

A new 120-ton mill is nearing completion at the **Empire** copper mine in Custer County, Idaho. It is being built by William Shafer and Denver Criner of Mackay for Robert Lloyd of Coachella, California, who purchased the mine recently. A small crew is doing development work under direction of Dave Bell, mine manager.

Mill feed at the **Lucky Friday** mill east of Mullan, Shoshone County, Idaho has averaged 19 ounces of silver, 10 percent lead and 1 percent zinc per ton since the mill went into operation last February. Recoveries have averaged 98 percent. L. J. Randall, Wallace, Idaho is president of **Lucky Friday Silver-Lead Mines Company.**

Development of the **Hornet** vein at **Dayrock** mine of **Day Mines, Inc.**, in Shoshone County, Idaho has developed an ore length of 435 feet made up of four segments somewhat separated by faults. One raise followed the ore upward for 150 feet to reach the 950 level where it will be crosscut from pre-existing workings. The Hornet vein was discovered on the 1100-foot level a year ago.

Silver Buckle Mining Company, Inc., is planning a diamond drilling program on its claims west of Wallace, Idaho adjoining the **Galena** mine. Objective is an extension of a new silver-bearing vein found in the Galena north of the Polaris Fault on the 3000-foot level. The firm will receive nearly $250,000 as its share of the $1,000,000 which **Dawn Mining Company** paid this summer for the Peters and Boyd uranium leases operated by Silver Buckle in the Spokane Indian Reservation, Stevens County, Washington.

Reopening of the 100-foot Hibernia tunnel, driven in the 1930's, was started recently in the Coeur d'Alene mining region of Idaho by **Lexington Silver-Lead Mines, Inc.** The Hibernia claims are north of the rich **Lucky Friday** mine and the current objective is to do downhole drilling or to sink a winze on the lead-silver showing intersected in the tunnel when it was driven. J. A. Allen, Spokane, Washington is president of Lexington.

Gravel deposits above present valley floors in Idaho County's old Elk City gold area may in the future be economically workable for their titanium, thorium, zirconium and rare earth metals, according to the **Idaho Bureau of Mines and Geology.**

WHAT'S GOING ON. . .

NORTHWEST

A new publication by the Department of the Interior presents details on ore-dressing tests conducted by the U.S. Bureau of Mines on chromite specimens from three areas of the Pacific Northwest. The research centered on flotation methods of recovering chromite from fine-grained disseminated ores found in the John Day region of Grant County, Oregon; the Twin Sisters Area of Skagit County, Washington, and the Mouat chromite deposits of south-central Montana, which come from what is known as the Stillwater Complex containing the country's largest known chromite deposit. A copy of Report of Investigations 5646 "Flotation on Pacific Northwest Chromite Ores" may be obtained from the Publications-Distribution Section, Bureau of Mines, 4800 Forbes Ave., Pittsburgh 13, Pennsylvania.

Montana

Another step in the plans of **Webb and Knapp, Inc.**, to build a steel mill in the Anaconda, Montana, area was accomplished with the signing of a 20-year contract for the Bonneville Power Administration to supply electric power for the project. The contract calls for delivery of 120,000 kilowatts of power, half the supply to start July 1, 1963, and the remainder by the following November 1. The proposed steel mill costing between $30,000,000 and $40,000,000 will have an annual capacity of 350,000 tons. Scheduled to be the largest steel producing facility in the Northwest, it will use the new Strategic-Udy process to make steel from iron left in discarded copper slag at the **Anaconda Company's** smelter at Anaconda.

Northern Milling Company, Inc., is undertaking a $102,300 lead-zinc exploration project at the **Marietta** mine about 15 miles west of Townsend, Broadwater County, Montana. Drifting and crosscutting will be carried out as approved by the Office of Minerals Exploration, which will have 50 percent participation. Paul I. Raber is president and general manager of the company.

Spokane National Mines, Inc., has been operating its Bannack mill in Beaverhead County, Montana, on a one-shift basis, handling about 75 tons of ore daily. Mill feed is from the company's **Bannack** gold mine and **New Departure** silver mine. Both underground stoping and open-pit mining are employed. Earl Brooks is mill superintendent and Cline Tedrow of Spokane, Washington, is consulting geologist and mining engineer.

The **M & H Mining Company** has taken over the **Mt. Washington** group of claims which are located near Jefferson City, Montana. This gold-silver-lead-zinc mine had a large early day production, but it has been idle for many years. Some dozing work has been done on the property and plans call for drilling to probe the extension of the vein.

Washington

Construction of a 50-ton-per-8-hour shift jig plant has been started at the tungsten-tin open-pit mine on Silver Hill, five miles south of Spokane, Washington. The $60,000 plant will be operated by the builder, **H. Halvorson, Inc.,** Spokane construction firm which has an interest in the property along with Carl A. Coon, **Daybreak Uranium, Inc.,** and others. Bulldozer stripping over the last three seasons has uncovered a series of veins containing ore near the surface. Robert N. Roby, Spokane mining engineer, is in charge.

Underground mining operations have been started at the **Lynx Cats** open-pit barite mining operation on Eagle Mountain, Stevens County, Washington. Bulldozing at the property six miles east of Chewelah last summer uncovered a deposit of high grade ore and shipments were resumed following a year's shutdown. Due to unstable weather conditions, only one car of ore a week is being shipped at present, and when snow blocks road passage operation will be halted for the winter. Don E. Lewis is lessee and A. F. Bradeen is in charge of mining. The claims are owned by Phillip Skok, Gordon Lavigne, Ole Alm, and W. B. Moorhead of Chewelah. Future plans call for building a gravity mill.

The Spokane office of the United States Geological Survey is closing gaps in the geological mapping of the Spokane area. A. E. Weissenborn, regional geologist in charge, spent the summer mapping metamorphic and intrusive rocks in the Mount Spokane Quadrangle. Paul L. Weis is mapping the Greenacres Quadrangle to the south, which includes Mica Peak.

A survey of Washington's limestone resources is being made by two crews from the state department of conservation's division of mines. The work includes sampling of limestone deposits in Stevens, Pend Oreille, Ferry, and Okanogan counties. Samples are sent to Washington State University, Pullman, for analysis.

New deposits of buried mineral are being sought in Pend Oreille County by mining geologists of Washington State University's industrial research division, using latest geophysical and geochemical methods. James W. Crosby heads the project, being carried out under a $5,000 grant from Pend Oreille County Public Utility District No. 1.

Current development plans at the **Anderson** open-pin zinc mine of **Goldfield Consolidated Mines Company** in Stevens County, Washington, call for driving a 1,500-foot tunnel and a raise to the surface in order to tap three new ore deposits located by diamond drilling during the last three years. The new ore bodies, indicated by drill cores to lie one above the other, range up to 100 feet thick and 100 feet wide. The tunnel, to be driven in under a mountain from the bottom of the 100-foot deep Anderson pit, will be 15 feet wide and 15 feet high to permit use of Dieselized trucks for hauling ore. Future plans call for building a 1,500-ton-per-day flotation mill, and open-pit mining of a fourth ore body. The Anderson mine has been closed for several years because of poor zinc market conditions.

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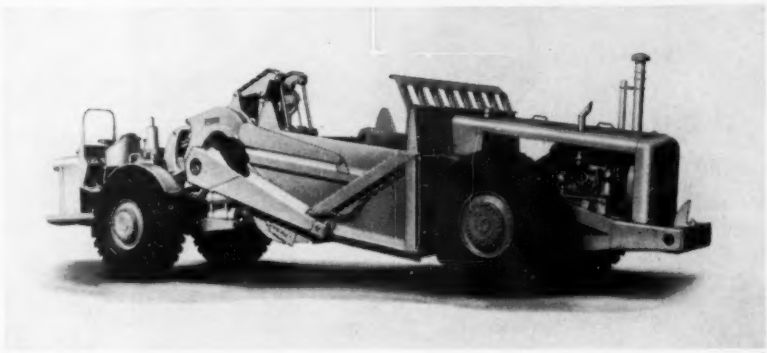
PRODUCTION EQUIPMENT preview

FOR DATA ON ANY ITEM IN THIS SECTION PLEASE USE YELLOW INQUIRY CARD OPPOSITE PAGE 52

Twin-Power 14 Yard Euclid Scraper Has 296 Total Engine Horsepower



After extensive testing, both on proving grounds and actual contractor operations, Euclid Division of General Motors has announced full production of a new twin-power scraper of 14 cubic yards struck capacity and 20 yards heaped S.A.E. rating at 1:1 slope. Designated as the Model TS-14, this all-wheel drive scraper is powered by two GM 4-71 engines, each with a separate Allison Torqmatic Drive consisting of torque converter and four-speed semi-automatic transmission. With converter lock-up in each Torqmatic Drive, maximum fuel economy is achieved with efficient use of the 296 total engine horsepower on grades and long high speed hauls.

Air assist remote control and full power shift enables operator to change from one speed range to another by a simple flick of the wrist to move the selector lever. No-spin differential is standard in both drive axles. Tires are 24.00 by 25. Two hydraulic jacks provide full 90° steering.

All scraper operations—bowl, apron and ejector—are hydraulically and independently controlled. The ejector is of the positive roll out type actuated by a hydraulic jack that is identical to the apron jack. Two inter-changeable bowl jacks are connected to the scraper bowl through heavy duty levers and linkage. Cutting edge consists of four sections that are identical and reversible. Circle No. 98.

Beryllium Field Detection

Developed for their use as consulting mining engineers, geologists and metallurgists, the Mineral Engineers of Salt Lake City, Utah, will now accept orders for their Qualitative Beryllium Field Detection Kit.

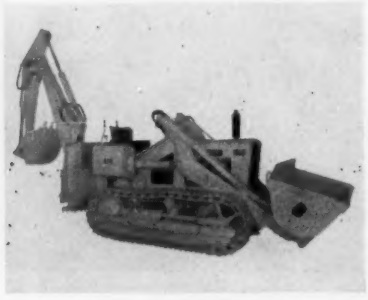
Enough reagents and materials are provided to run several hundred determinations based on a field method developed by the United States Bureau of Mines. The kits are assembled in an attractive metal carrying case and include all equipment needed to run determinations in the field.

It takes approximately five minutes to run a determination in the field, and the presence of beryllium can be positively determined Circle No. 88.

Fluorescent Mine Lighting

Two thousand feet beneath the surface, General Electric Power Grove configurated fluorescent lamps are being used to light up Morton Salt Company's mine at Fairport Harbor, Ohio. Power Groove lighting of key areas in the mine is credited with helping improve safety, miner comfort and production.

The entry cavern is lit by two-lamp fixtures, suspended four feet from the 20-foot ceiling. The fixtures provide about 30 footcandles after nine months of operation. There have been no burnouts after an estimated 3,000 hours of operation, representing important savings in maintainance. Circle No. 86.

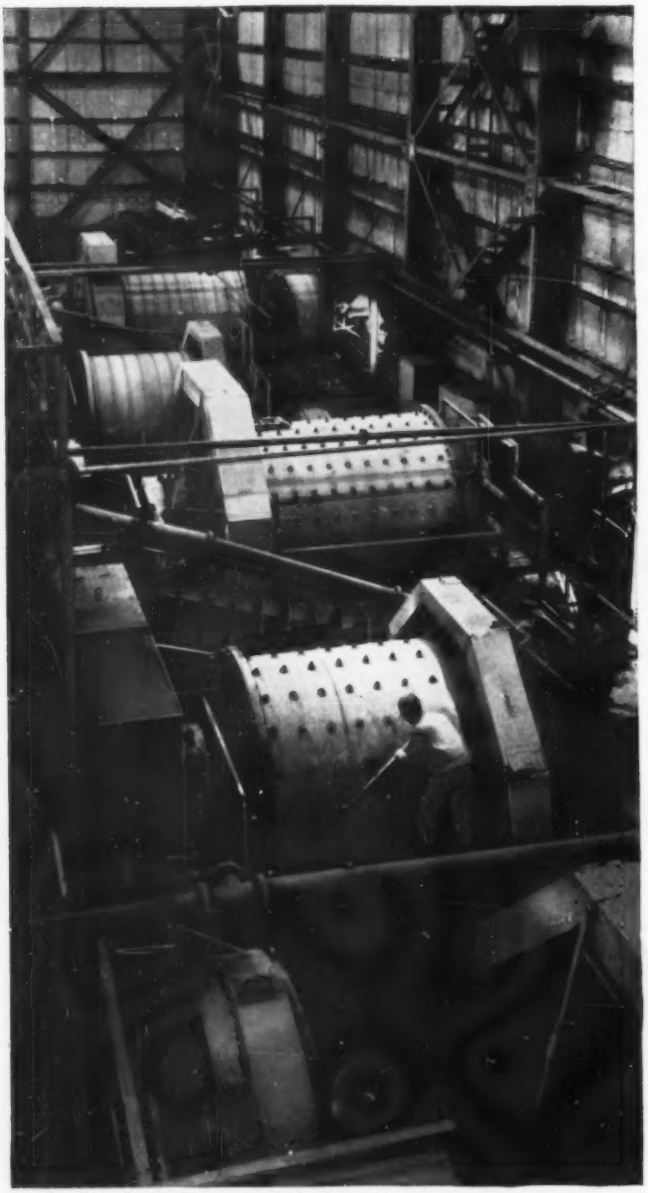


Expanded Equipment Line

John Deere is expanding its range of power sizes in the complete new line of tractors and equipment it has developed for the earthmoving, logging, landscaping and material handling field. This equipment includes backhoes, loaders, bulldozers, and specialized tools.

All the tractors will have power-matched equipment, and will feature new John Deere built variable-speed engines. Gasoline and Diesel options will be offered throughout the line.

New hydraulic controls to increase work output and quality through simplified earthmoving equipment operation are included on the new line. Circle No. 2.



On feed end, discharge and shell, Ni-Hard liners have been used in these mills for the past 11 years at the New York Ore Division of Jones & Laughlin Steel Corporation.

Will be good to the last ¼ inch. Note retention of original contour on these Ni-Hard shell liners, in rod mill service. There's plenty of tonnage left in them.

Proof from Jones & Laughlin!

Ni-Hard liners last more than 2½ years, grind more than 2 million tons of iron ore

Here's proof of the long and uniform liner wear you can get with Ni-Hard* nickel-chromium-iron alloy... used here by Jones & Laughlin in both rod and ball mills wet-grinding iron ore.

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- Ni-Hard liners deliver an average life of 32 months of non-stop, round-the-clock service per set ... each set grinding more than 2½ million tons of ore.
- Ni-Hard liners save thousands of *hours* of down-time, and thousands of *dollars* in repair and replacement costs.

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To get the facts on Ni-Hard iron, just call or write your nearby producer of Ni-Hard castings. Or write Inco for the helpful 58-page booklet, "Engineering Properties and Applications of Ni-Hard." A copy will be mailed to you immediately without charge or obligation.

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GENERATOR SET brochure entitled "GM Diesel Generator Sets for Standby and Continuous Off the Line Power" has just been released by GM Diesel. For your free copy of this eight-page brochure circle No. 3.

LIQUID CYCLONE bulletin No. 2503 has been revised and reissued by Dorr-Oliver Inc. This eight page brochure describes rubber lined DorrClone liquid cyclone classifiers. Circle No. 4.

PORTABLE LIGHTING systems for practically every use can be quickly and easily assembled from Joy industrial lighting components. Bulletin B76, just issued by the Joy Manufacturing Company, provides detailed information. Circle No. 8.

LOADER: New 9,000-pound capacity Case W-12 loader—a four-wheel drive, rear-wheel steer unit for materials handling, mine and quarry work, etc.—is described in a new 16-page catalog just released by J. I. Case Company. Circle No. 9.

WELDING ALLOY catalog and instruction manual is offered free by All-State Welding Alloys Company, Inc. This new 56-page welding, brazing and soldering alloy and flux catalog is also offered in Spanish. Circle No. 12.

LIQUID FEEDERS are described in new bulletins issued by The Clarkson Company. These instruments are adjustable for controlled, precise feeding of a few drops to 2,000 cc per minute. Circle No. 16.

CONSTRUCTION and bulk materials handling equipment made by the Clark Equipment Company is described in a new 28-page, four-color catalog just issued. Circle No. 17.

IMPACT BREAKERS manufactured by the Sheepbridge Equipment Ltd. are described in an eight-page bulletin recently released by the company. These machines are suitable for primary and secondary crushing with high efficiency and low cost. Circle No. 18.

DIESEL ENGINES for all types of mechanized equipment in a full range from 5 to 310 BHP in 1, 2, 3, 4, 6, 8 and 12 cylinders are manufactured by Deutz Diesel Energy Corporation. Circle No. 29.

INDUSTRIAL PUMPS are described in the latest free catalog issued by John Bean. High pressure reciprocating pumps with capacities from 0.5 to 100 gpm and pressures from 100 to 12,000 psi are detailed. Circle No. 30.

CORE DRILL that is portable, lightweight, easy to set up and operate is the Packsack model made by the Acker Drill Company. This efficient compressed air powered drill is detailed in their bulletin 22-MW which is sent to you free by circling No. 31.

WEMCO has announced the availability of a new bulletin describing the Mineral Master, a multiple purpose lab machine for flotation, agitation and attrition batch testing. Circle No. 32.

VERSATILE CRANE: A new, colorful, 12-page catalog available from Unit Crane & Shovel Company describes the Unit Model 614, a ¾-yard, excavator-crane convertible to dragline, trenchoe, clamshell, and magnet attachments. Circle No. 33.

TRACING PAPERS that have non-reproductive cross section rulings are available from Ogilvie Press, Inc., Brooklyn, New York. These quality papers have high transparency, top strength and give excellent reproduction. Circle No. 34.

CASTINGS of steel, alloy steels, and iron are described in an eight-page pamphlet issued by U. S. Foundries Inc. of Denver, Colorado. Five pages devoted to casting defects and definitions are particularly valuable to foundry men. Circle No. 35.

REAR DUMP TRUCK that carries a 150-ton payload is described along with the many services offered by the Western Contracting Corporation in an attractive multi-colored brochure just released by this fast-growing company. Circle No. 36.

CENTRIFUGAL PUMPS: New bulletin illustrates and describes the line of vertical single-stage split case centrifugal pumps recently announced by Aurora Pump Division, The New York Air Brake Company. Circle No. 37.

LOOSE DIAMONDS, facts, assortments, uses and standard categories are the subject of a four-page brochure issued by the Diamond Tool Research Company, Inc. Circle No. 38.

PRIMACORD DETONATING FUSE, What it is—How to use it, is the title of a new, 72-page, pocket size catalog and manual that illustrates and describes detonating fuse for commercial blasting. For a free copy circle No. 40.

MECHANICAL POWER transmission equipment is the subject of Wood's catalog 23103 which describes and illustrates the company's complete line of products. Circle No. 41.

NEW COMPRESSED AIR filters feature coalescent action that removes practically 100 percent of the entrained dirt, oil and water from the air and normally operate for months without maintenance are described in a seven-page brochure by King Engineering Corporation. Circle No. 42.

MINERALS FLOTATION Bulletin F5-B32 describing the principle of the flotation process, as well as the design, construction and operating characteristics of WEMCO Fagergren flotation cells is available from Western Machinery Company. Circle No. 22.

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"EQUIPMENT Catalog and Hydraulic Reference Manual" is the title of a new 64-page book being distributed free by the Groban Supply Company. Catalog covers electrical, hydraulic and mechanical items used for original manufacture or maintenance in every industry. Circle No. 23.

ROPE THREADS are smooth, shallow depth, rounded threads on bits and steels exclusive with Sandvik Coromant which permit quick hand uncoupling. Circle No. 24.

CONCENTRATING TABLE: The Super-Duty Diagonal Deck table manufactured by the Deister Concentrator Company, Inc. is the subject of their bulletin No. 118C. Low cost and high mineral concentrating efficiency are the features of this table. Circle No. 26.

ROTARY KILNS are the subject of Bulletin No. 1115 published by Traylor Engineering. Modern design, high efficiency and low cost are the features of Traylor kilns. Circle No. 27.

LUBRICANTS for wire rope, open gears, dipper sticks, and cams are supplied by The Whitmore Manufacturing Company. These protective lubricants are now available in aerosol cans. Circle No. 20.

HARD-FACING ELECTRODE for reclaiming such equipment as large sprockets, churn drills, drive tumblers, tractor grousers and most parts subjected to severe impact and abrasion is announced by Stoody Company. Circle No. 21.

NEW BIT with chiseled teeth has been announced by the Varel Manufacturing Company for faster drilling of medium hard formations. Available in sizes 7⅞, 8⅝, and 9 inches, the new bit is designed for drilling in shale, slate, hard anhydrites and limestone. Circle No. 51.

REFERENCE TABLE for engineers in wall chart form is offered free by the Precision Equipment Company. Chart includes common conversions such as inches to centimeters, microns to meters, cubic feet to liters, etc. Circle No. 45.

TRUCK COST record books and forms for driver daily reports to assist truck users in evaluating the performance of their equipment are being offered free of charge by the motor truck division of International Harvester Company. Circle No. 46.

LABORATORY INSTRUMENT that transforms any scaler with a high voltage supply into a complete proportional counting system is announced by Nuclear Measurements Corporation. Circle No. 47.

NEW FILTER that will provide positive protection for compressed air operated equipment against oil, rust, dust and other contaminating particles as small as five microns is the "Whirle-Flo" Filterator made by the Wilkerson Corporation. Circle No. 49.

VIBRATING FEEDERS used for high capacity controlled feeding of ore, rock, shale, and other highly abrasive bulk materials incorporate a new principle of vibration according to the Link-Belt Company. Circle No. 50.

TILTING PAN FILTERS that are becoming increasingly useful in chemical and metallurgical processing are described in an attractive eight-page bulletin released by The Eimco Corporation. Circle No. 19.

SLIDE RULE: General Industrial Company has started production on a handy circular slide rule for engineers and executives who must perform simple calculations in their work. This convenient, pocket-size calculator is given free to those who circle No. 53.

RIPPER POINT that is designed to dramatically increase ripping yardage has been introduced by the Construction Equipment Division of ESCO. The production advantages of the new point are made possible by the radical length, narrowness and sharpness of the design and a new ESCO alloy. Circle No. 52.

"HANDBOOK OF CRUSHING" is the title of a new 40-page book just released by The Pennsylvania Crusher Division of the Bath Iron Works. The book is amply illustrated with diagrams and charts for easy understanding. For a free copy circle No. 25.

PUMPING AND HYDRAULIC data plus other useful information is contained in a new manual just released by Peerless Pump. Cost of electrical pumping, how to survey a deep well, methods for testing pumps, etc. are a few of the helpful facts contained in the new 20-page manual. Circle No. 44.

CRANE CONTROL is the subject of Bulletin GED-3568 issued by the International General Electric Company. Titled "Let's Talk DC Crane Control", it presents the facts concerning the GE crane hoist circuit based on years of circuit analysis and actual load tests. Circle No. 39.

EPOXY ADHESIVES are now available in kit form from the Schwartz Chemical Company. Three new epoxy adhesive kits, recommended as room temperature curing materials, are manufactured by this New York firm. Circle No. 58.

BUCKET-WHEEL EXCAVATORS are detailed and described in an 18-page illustrated booklet published by LMG of West Germany who are represented in the United States and Canada by the Link-Belt Company. Circle No. 59.

EYE AND FACE PROTECTION: A completely new selection of eye and face protection for a wide variety of industrial applications is described in a brochure available from Mine Safety Appliances Company of Pittsburgh. Circle No. 60.

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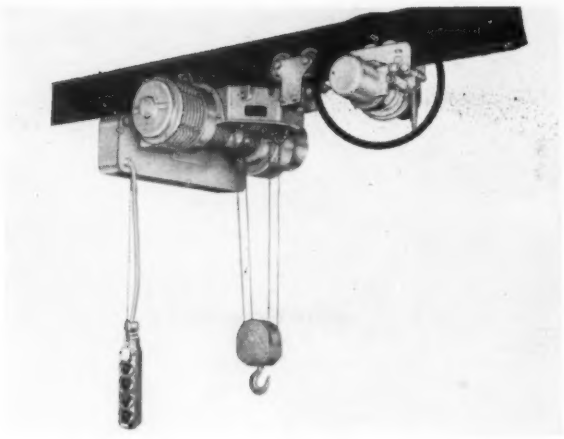


Powerful New Monorail Hoist-Tractor

Loads of 13,000 pounds can be pulled at speeds up to 60 feet per minute with a powerful new monorail "hoist-tractor" just introduced by Harnischfeger Corporation of Milwaukee. The new unit, known as the P & H Pull-a-Hoist, is designed to power any make of hoist along any standard "I" beam or wide flange beam.

A chief feature of the Pull-a-Hoist is the convenience with which it can be installed. It weighs only 83 pounds, needs no engineering, requires 12 inches of headroom, and uses only 13 inches of rail space for "end approach." Operating features of this new unit include oil-smooth adjustable torque brake and a special "soft-start" motor which minimizes any tendency of load jerking or swaying regardless of size.

Immediate travel response is answered by the fact that power is transmitted to the underside of the beam by a solid neoprene-tired drive wheel which is under positive adjustable spring pressure. This is said to provide the Pull-a-Hoist with more positive tractive power than is possible from a conventional pneumatic-tired wheel. Circle No. 94.

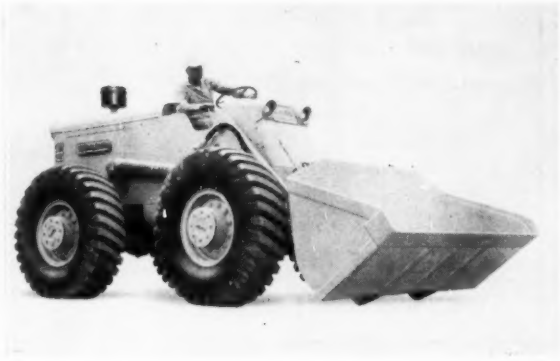
New 4-Wheel Drive Tractor-Shovel

The biggest, most powerful model in their line of four-wheel drive loaders has been announced by the J. I. Case Company, Racine, Wisconsin. Called the W-12, this new high-speed, high-production model has a carry capacity of 9000 lbs., breakout capacity of 23,500 lbs. Its standard loader bucket is SAE rated at 2-½ cubic yards. However, optional buckets with SAE rated capacities of 1-¾ and 3-½ cubic yards are also available.

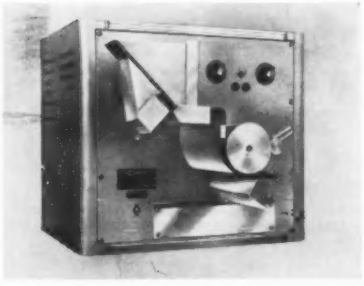
Designed around a Case-built 120 hp diesel engine that had been thoroughly field proved in field use, the W-12 is said to be priced substantially lower than comparably rated machines utilizing engines and components furnished by outside suppliers.

W-12's advantages include: torque converter drive that automatically and instantaneously more than triples engine output torque to meet increasing loads . . . constant mesh transmission that provides speeds from 0 to 23 mph in forward or reverse through three speed ranges . . . power transfer differential for all four drive wheels . . . power shift . . . power steering . . . power brakes.

The new machine also features forward-pivoted lift arms which



provide complete operator safety . . . nine-foot dump clearance . . . one-foot digging depth and 360° visibility. Circle No. 95.



Field Magnetic Separator

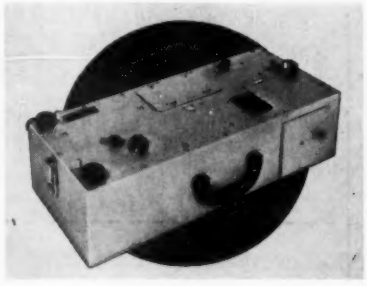
This compact unit is equipped with a vibrating feed hopper attached to a pan formed into a downward volute curve which "curtain feeds" material to be separated under a cylindrical stainless steel housing. Inside are permanent magnets rotating on a hub in a direction counter to the downward fall of the material. Made by Carpco Manufacturing Company of Jacksonville, Florida, this type of separator was developed primarily to remove magnetite and other highly magnetics from granulated materials in the dry state, with high recovery efficiencies.

This unit, Model RF-1660, handles feed rates to 600 lbs. per hour; and the flux may be adjusted to make differential low intensity separations. Circle No. 5.

Dual Hitch Dragline Bucket

The Page Engineering Company specialists in dragline equipment, have announced the latest, most outstanding development in dragline digging equipment since the introduction of the Page Automatic Dragline Bucket. This is the new dual hitch, all-purpose bucket that provides the operator of any dragline machine with the ultimate in digging equipment that surpasses any dragline bucket ever manufactured. This bucket can be readily adjusted in a matter of minutes to dig at any desired depth above or below the fairlead with the same degree of uniform digging efficiency and capacity.

Page dragline buckets are available in any size to meet the particular job requirements. Circle No. 7.



Easy to Use Seismograph

This instrument, a product of W. F. Sprengnether Instrument Company, St. Louis, Missouri, provides an effective, simple method of determining the true value of vibrations. A major application for it is to measure the effect of vibrations on buildings and other structures caused by pile driving and explosives. It is also useful in construction to determine the ability of structural members of a building to withstand earth -quakes, blasting, vibrations from automobiles, traffic, etc.

The unit, using no external power source connections, can be set up in minutes and requires no technical training to operate. Self-contained in a rigid aluminum carrying case. Circle No. 6.

Metal & Mineral Prices

U.S.A.

METALS

November 18, 1960

COPPER: **Electrolytic.** Delivered F.o.b. cars, Valley basis (pound) ..... 30.00¢
Lake. Delivered, destinations, USA ..... 30.00¢
Foreign. Delivered, destinations, USA ..... 30.00¢
LEAD: **Common Grade.** New York (Per pound) ..... 12.00¢
Tri-State Concentrate, 80% lead, per ton $141.72
ZINC: **Prime Western:** F.o.b. E. St. Louis (Per pound) ..... 13.00¢
Prime Western: Delivered New York ..... 13.50¢
Tri-State Concentrate, 60% zinc per ton $80.00
ALUMINUM: **Primary 50 Pound Ingots (99.5% plus)** (Per pound) 26.00¢
ANTIMONY: **Lone Star Brand. F.o.b. Laredo, in bulk** (Per pound) 29.50¢
BISMUTH: (In ton lots) price per pound $2.25
CADMIUM: **Sticks and bars.** 1 to 5 ton lots Price per pound .. $1.60
COBALT: **97-99%,** keg of 500 pounds (Price per pound) $1.50
COLUMBIUM: **Ingot** ..... Nom., per pound $55.00-$85.00
GERMANIUM: dioxide, high purity, gram ..... 29.95-36.95¢
LITHIUM: **98%** (per pound) ..... $9.00-$12.00
MAGNESIUM: **Ingots (99.8%)** F.o.b. Velasco, Texas per pound 36.00¢
MERCURY: **Flasks.** Small lots, New York ..... $208.00-$210.00
NICKEL: **"F" Ingots (5 pounds).** F.o.b. Port Colbourne, Ontario 75.50¢
PLUTONIUM: To July 1 1962 AEC will pay $30.00 to $40.00 per gram depending on plutonium 240 content. July 1, 1962 to June 30, 1963, per gram $30.00
SELENIUM: **99.5% per pound** ..... $6.50-$7.00
TELLURIUM: Common grade, Per pound $4.00
THORIUM: per kilogram $43.00
TIN: **Grade A Brands.** New York (Per pound) Prompt delivery 103.625¢
TITANIUM: **99.3%** + Grade A-1 Sponge (Per pound) ... $1.50-$1.60
URANIUM: **Rod** (0.790 U-235) $16.00 Per Pound; Foil $16.75
U-235: **Nominal** (Per pound) $7.725
GOLD: **United States Treasury Price** ..... $35.00 per ounce
SILVER: **Newly mined domestic.** U.S. Treasury price per ounce 90.5¢
Foreign Handy Harmon ..... 91⅜¢
PLATINUM: Per ounce ..... $82.00-$85.00
ZIRCONIUM: **Sponge,** Per pound, Reactor Grade $5.00

ORES AND CONCENTRATES

BERYLLIUM ORE: **10 to 12% BeO.** F.o.b. mine, Colorado $46.00 per unit Small lot purchases at Custer, S. D., Spruce Pine, N. C., and Franklin, N. H. Visual inspection at $400.00 per short ton or by assaying at 8.0 to 8.9% BeO, $40 per unit; 9.0 to 9.9%, $45; over 10.0%, $48.00.
CHROME ORE: F.o.b. railroad cars eastern seaports. Dry long tons.
African (Rhodesian). 48% Cr_2O_3. 3 to 1 Ratio ..... $35.00-$36.00
African (Transvaal). 48% Cr_2O_3. No ratio ..... $26.00-$28.00
Turkish, 48% Cr_2O_3. 3 to 1 chrome-iron ratio Nominal $36.00-$37.00
U.S. Government ore-purchase depot Grants Pass Oregon. Buying suspended, quota filled.
COLUMBIUM-TANTALUM ORE: Per Pound Pentoxide Nominal $1.10
IRON ORE: **Lake Superior. Per gross ton Lower Lake Ports**
Mesabi, Non Bessemer, 51.5% Fe $11.45
Mesabi, Bessemer, 51.5% Fe $11.60
Old Range Non Bessemer $11.70
Old Range Bessemer $11.85
Lump: Plus ½-inch $12.85
Fines: Minus ½-inch $10.72
Swedish, Atlantic Ports, 60 to 68% Fe Contracts, Per Unit ..... 24.00-25.00¢
MANGANESE ORE: **Metallurgical grade.** 48 to 50% Mn Long ton unit ..... $0.95-$1.00
Metallurgical grade. 46 to 48% Mn. Long ton unit .... $0.90-$0.95
Metallurgical grade. 44 to 45% Mn. Long ton unit .... $0.85-$0.90
Domestic U.S. Government. GSA Basis $2.30 per unit for 48% Mn.
MOLYBDENITE CONCENTRATE: **90% MoS_2 F.o.b.** Climax, Colorado. Per pound Mo, plus container cost $1.25
TUNGSTEN CONCENTRATE: **Domestic.** 60% WO_3 Per short ton unit ..... Nominal $24.00
Foreign: 65% WO_3 Per short ton unit (Scheelite) .. Nominal $20.25
Foreign: South American, Spanish, Portuguese .... Nominal $20.00
URANIUM ORE. F.o.b. purchase depot or company mill in accordance with AEC schedules and company buying contracts. Basic price is $1.50 per pound of U_3O_8 in ore assaying 0.10 percent. For each additional 0.01 add 20¢. Subject to development allowance, premiums, penalties where applicable.

NON-METALLIC MINERALS

BARITE: Oil well drilling. Minimum **4.25 specific gravity,** per short ton $16.00
BENTONITE: **Minus-200mesh.** F.o.b. Wyoming. Per ton, carload lots $12.50
Oil Well grade. Packed in 100 pound paper bags $14.00
BORON: technical grade .. F.o.b. Boron California. Per ton .. $47.50
FLUORSPAR: **Metallurgical grade.** 72.5% effective CaF_2 content per short ton F.o.b. Illinois-Kentucky mines ..... $37.00-$41.00
Mexican. 70% F.o.b. border ..... $28.00-$29.00
Acid Grade. 97% CaF_2 Bulk, F.o.b. mine ..... $45.00-$49.00
PERLITE: **Crude:** F.o.b. mine per short ton ..... $3.00 to $5.00
Plaster grades. Crushed and sized. F.o.b. plants .... $7.00 to $9.00
SULPHUR: Long ton, F.o.b. Hoskins Mound, Texas .... $22.50-$23.50

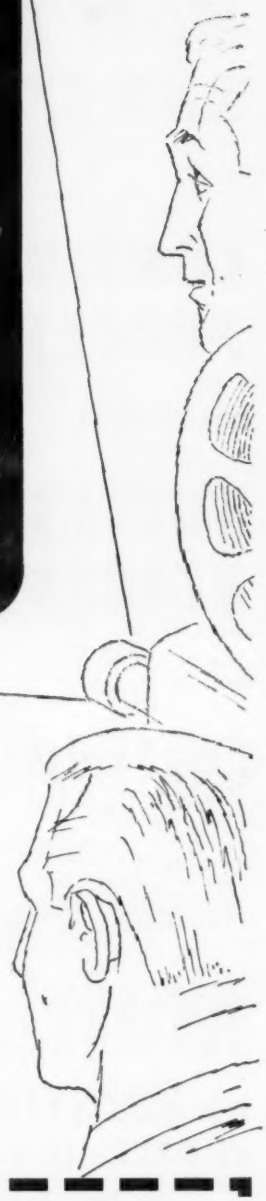
London

November 18, 1960

		Per Long Ton	USA Equivalent	cents per pound
COPPER:	Electrolytic spot	£224	10s 0d	28.06¢
LEAD:	Refined, 99%	£ 67	0s 0d	8.38¢
ZINC:	Virgin 98%	£ 86	7s 6d	10.80¢
ALUMINUM:	Ingot, 99.5%	£186	0s 0d	23.25¢
ANTIMONY:	Regulus, 99.6%	£197	10s 0d	24.69¢
TIN:	Standard, 99.75% ...	£807	10s 0d	100.94¢
TUNGSTEN:	Long ton unit	£ 0	145s 0d	$20.30¢

*With Sterling Pound at $ 2.80

Quotations on metals and certain ores through the courtesy of *American Metal Market, New York, N. Y.*



Underground filmed report shows how one mine moves hard rock for less than 20¢ a ton . . .

You have probably heard of the Young Mine of American Zinc, Lead and Smelting Company and wanted to see their operation. It is believed to be one of the world's most economically-operated hard rock mines. Many have come to observe their methods, several from foreign countries. This mine operates two shifts. A total of only 95 hourly employees produce more than 3,000 tons daily. The low cost operation is the primary result of the tremendous tonnage moved by self-loading transports manufactured by Sanford-Day. Three of these S-D Transloaders, requiring only three men per shift, load, haul, and dump all the ore produced. Total cost is less than 20¢ a ton. This includes cost of original investment, maintenance and labor. Another feature of this mine that visitors observe and ask questions about with a great deal of interest is the haulage equipment. Only 28 S-D Automatic Bottom Dumping mine cars are necessary to haul the entire 3,000-ton daily production to tipple and it costs less than 4¢ a ton. We recently completed and have available now for your study a documentary 18-minute color-sound 16mm movie showing every phase of this low cost operation — from drilling to transportation of ore to mill. Ask us to mail this film to you for showing to your operating personnel . . . or, ask us to have one of our representatives bring projector and the movie to show for you. Write or call us today. Use coupon below to make mail request.

SANFORD-DAY • P. O. Box 1511 • Knoxville, Tenn.

☐ We have sound projector. Please mail film "One Man! One Machine! LOAD HAUL DUMP" direct for review and study.

☐ Please have your representative contact me. We would like to have him visit us to show the movie "One Man! One Machine! LOAD HAUL DUMP"

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____

MOST VERSATILE AND EFFECTIVE

FOR

CONTINUOUS PROCESSING

THROUGH

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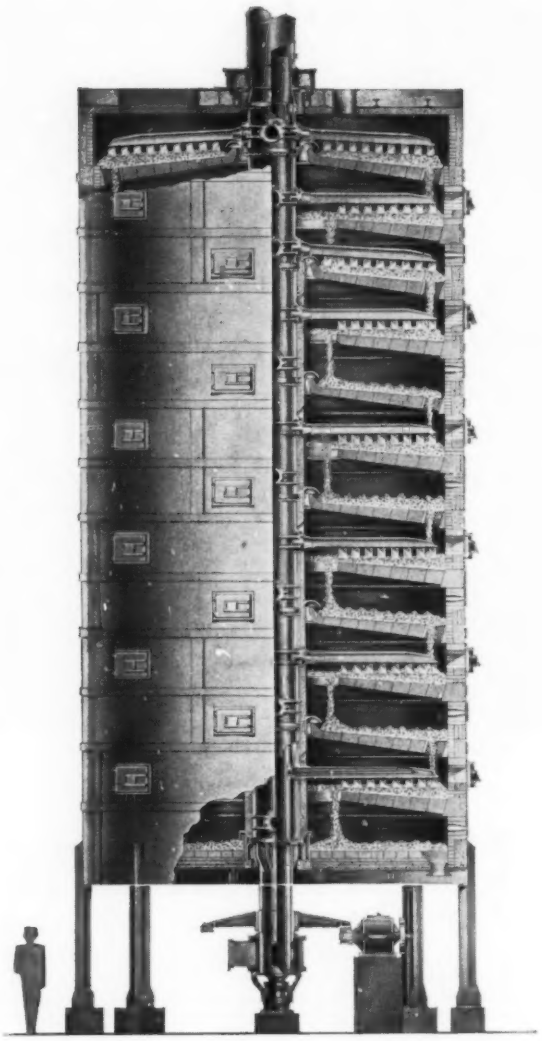
OF

CONTROLLED HEAT



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for ROASTING • CALCINING • DRYING of ORES • CONCENTRATES • CHEMICALS • SLUDGES • WASTES

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PFM Multiple Hearth Furnaces range in size from small laboratory installations to 16-hearth giants. Complete facilities are maintained for analysis, tests, and pilot runs. You are thus assured of a furnace design, based on actual test operation, that will most efficiently meet your exact requirements.

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INTERNATIONAL NEWS

Commonwealth Congress in South Africa Opens April 10

Johannesburg, South Africa, will be the starting point next April for the 41 days of the Seventh Commonwealth Mining and Metallurgical Congress. The session promises to provide delegates throughout the world with a rare opportunity both to see the mineral wealth and scenic grandeur of the area and to hear leading engineers of the industry present some 100 technical papers on mining and related fields.

The Congress begins April 10 and closes in Salisbury, Southern Rhodesia, May 20. As hosts, the mineral industries of the Union of South Africa, Southern and Northern Rhodesia assure those who plan to attend that current disturbances in the Congo will present no difficulties.

Tours of mining and other areas that delegates may wish to take in South Africa include: Witwatersrand Gold Mines; Natal and Orange Free State; Orange Free State Gold Field; Vereeniging; Northwestern Transvaal; Kimberley-South West Africa; Klerksdorp; Capetown-Kimberley-Klerksdorp, and Kruger Park Reserve.

In Northern Rhodesia arrangements have been made for visits to Roan Antelope, Rhokana, Mufulira, Nchanga, Rhodesia Broken Hill, Chibuluma and Bancroft mines. Ndola refineries, and the old Bwana Mkubwa workings. Attractions for delegates in Southern Rhodesia include tours to Victoria Falls, Bikita Lithium Mines, the Zimbabwe ruins, Shabanie Asbestos mines, Wankie coal fields, Kariba dam, Manbula copper mine, and the Selukwe and Umvukwe chrome mines.

Further information about the Congress may be obtained by writing immediately to Mr. Hugh Husted, Congress Manager, Seventh Commonwealth Mining and Metallurgical Congress, Box 809, Johannesburg.

Mauritania Iron Project Nears Development Stage

With major financial and transportation problems solved, the Khedia hills iron ore project in Mauritania is approaching the development stage. Work on the site began late in the summer and ore is expected to be on the market in mid-1965.

Plans call for immediate output of 4,000,000 tons a year, with an increase to 6,000,000 tons a year within five years. Exploration was begun in 1952 by a French, British and Canadian consortium, known as MIFERMA, or Societe des Mines de Fer de Mauritanie.

Iron content of the deposits has been estimated at between 63 and 68 percent. Proven reserves are set at 125,000,000 tons, which can be mined by open-pit methods.

The deposits currently investigated by MIFERMA are in the Khedia d'Idjil, a range of hills shaped like a right triangle which extends 25 kilometers from east to west and 10 kilometers from north to south. Within the area the elevations vary 1,500 feet from the desert plain near Fort Gouraud. In the Khedia three areas have been explored: Tazadit at the northeastern end; F'Derik at the west, and Rouessa in the center. Reserves at the three are Tazadit, 87,000,000 tons; F'Derik, 23,000,000, and Rouessa, 14,500,000.

Tazadit, which will be mined first, contains mainly laminated ore, in the form of a homogeneous mass at a dip of 50 to 60°. Average thickness is about 150 meters. Although studies have been made over a length of 1,200 meters from its crest of 750 meters to a depth of 350 meters, the actual depth of the ore body has not yet been determined.

At the F'Derik deposit where mining will start later, the ore is compact and made up of a dipping layer up to 50 meters in thickness.

Hartebeestfontein Sets World Shaft Record of 1,106 Feet

A new shaft sinking record—1,106 feet in one month—was set in October by Hartebeestfontein Gold Mining Company Ltd. at its Klerksdorp district mine in the Transvaal. The new world record was achieved just 11 months after President Steyn Gold Mining Company reached the long-sought goal of over 1,000 feet in a month, by sinking 1,001 feet.

Hartebeestfontein's achievement came in sinking its No. 4 shaft, a 26-foot lined diameter unit, through 721 feet of precementated dolomite and the balance in

WHAT'S GOING ON. . .
INTERNATIONAL

lava. Shaft sinking began in August and by the end of September had reached 799 feet. The shaft will be sunk to a depth of 7,500 feet, with concurrent lining.

Located about 1,000 feet north of the company's southern boundary, the No. 4 will serve operations into the eastern section of the neighboring Zandpan mine, and into recently acquired claims between the Hartebeestfontein-Vaal Reefs lease area, as well as serving to open up deep levels. The shaft will be connected with the No. 2 shaft area about 8,000 feet northeast.

5,000,000-Ton Deposit of Lead Ore Discovered in Morocco

An important lead deposit has been located in the valley of the Moulouya in Morocco by the Bureau of Mining Research and Development (BRPM) which has undertaken a survey of the area.

At present reserves are estimated at 5,000,000 to 6,000,000 tons of ore, averaging about 3.0 percent lead, which can be mined by open pit methods. A pilot washing plant will be put in service soon.

Present plans call for further studies about the characteristics of the deposit and best methods to be used in establishing an operation to mine and mill 2,000 to 3,000 tons of ore per day. Estimated cost of the project is close to 2,000,000,000 Moroccan francs.

Another Moroccan lead-zinc deposit has been located at Djebel Bou Arhous, between Guorrama and Beni-Tadji. It will be developed by the SOGEMI, in which BRPM has a 50 percent interest.

Africa

UNION OF SOUTH AFRICA—Plans are being made for a reopening early next year of the **Driekop** platinum mine in the Western Transvaal. This mine as well as the rich **Tsumeb** mine in South West Africa was operated before World War II by the **Otavi Minen and Eisenbahn Gesellschaft.** After the war the Tsumeb property was acquired from the Custodian of Enemy property by a consortium comprised of **Newmont Mining, American Metal, O'Okiep Copper, Selection Trust, Union Corporation** and the **South-West Africa Company** for about $3,000,000, but the Otavi platinum mine remained dormant. Recently the government has released some of the Otavi company's confiscated funds, leading to the present plans for reopening that mine.

FEDERATION OF RHODESIA & NYASLAND—All three mines of the **Rhodesian Selection Trust Group** increased production and output for the fiscal year which ended June 30. **Mufulira** produced 103,710 long tons of copper compared with 88,056 the previous year in which there was a strike; **Chibuluma**'s output was 22,054 long tons of copper, compared with 19,235 for 1959, and **Roan Antelope**'s tonnage was 91,990, an increase of some 10 percent over the 1959 figure of 80,873 long tons.

Latin America

CHILE—**Compania Disputada de Los Condes** is planning to increase production by changing from glory hole to block-cave mining at its copper mine in the Department of Santiago. The property is on the southwest slope of the mountain range on which **Cerro de Pasco Corporation's Rio Blanco** property is on the northeast slope. Capacity of the Disputada de Los Condes mill at Les Condes will be increased to 3,000 tons a day and later to 6,000 tons.

HONDURAS—An agreement by **Standard Magnetite Corporation** of New York and **Honduras Mining & Development Co., Inc.,** of Dallas, Texas will result in development of a large iron ore deposit. The project calls for Standard Magnetite to spend about $3,000,000 in developing the property, which includes possible construction of a railroad to haul the ore to the Honduras coast from the mine site, located about 15 miles inland from the small north coastal town of Tela. According to Garrett Combs, president of Honduras Mining, which owns the property, the company expects that within three years the deposit will start yielding more than 2,000,000 tons of magnetite a year. The firm also owns rights to other mining properties in this country and in Guatemala.

CHILE—**Corporacion Minera de Atacama,** Chilean subsidiary of the Japanese **Mitsubishi Mining Company,** is regularly shipping ore from its new **Las Andrianitas** iron mine near Copiapo to Tobata, Kyushu, Japan. Atacama will supply 340,000 tons of iron ore a year to **Yawata Iron and Steel Company** of Japan during the next 15 years.

PERU—**South American Placers, Inc.** of New York has started an exploration program on placer grounds in southeastern Peru, where it has optioned property owned by Sixto Gutierrez of Arequipa, operator of several mines in the area. The company is using two drills, a heliocourier and a plane in its exploration of the grounds along the upper Inambarai river and tributaries. Lewis Harder, Patrick O'Neill, and W. H. Breeding, top executives of South American Placers, were in Peru recently in connection with the project and their plans for opening an Arequipa office.

MEXICO—A new mining firm, **Cia Consolidada de Minas, S.A. de C. V.,** has begun exploration work at gold, silver and lead mines in the area near Acaponeta, Nayarit. Miguel Camarena is president of the company.

BRAZIL—Preliminary economic and technical studies are being carried out by the **Rio Tinto Company Ltd.** concerning iron ore deposits in Minas Gerais province. **Yawata Iron and Steel Company** of Japan is negotiating with Rio Tinto for a long-term contract to purchase iron ore from the potential operation.

SURINAM—A $1,500,000 loan approved recently by the World Bank will be used for an extensive survey of mineral deposits that will provide information on the possible existence of iron, titanium, copper, nickel, cobalt, and radio-active minerals. The project was approved earlier by the United Nations Special Fund which has allocated $770,000 for the cost of the survey during the next two or three years. The government of Surinam had previously undertaken airborne reconnaissance which indicated several areas that justify further geophysical study. Surinam is presently a major source of bauxite for **Aluminum Company of America** and a supplier for other aluminum processors.

MEXICO—The Mexican government has undertaken a detailed investigation of two iron-producing areas—the Isthmus of Tehuantepec and the mining area of Colima and Michoacan, which is expected to be the source of supply for a steel mill which will be built at Manzanillo in five or six years. Another iron-producing region under study is that along the Pacific coast, between Jalisco and Oaxaca. Exploration there reveals presence of large iron ore reserves.

ARGENTINA—Studies of the manganese deposits at the **Farellon Negro** mines in the province of Catamarca indicate ore grade is 41 percent Mn and 10 percent Fe. When developed, it is expected the operation will have an output of 120 tons of manganese daily for shipment to the San Nicolas steel plant in Buenos Aires province. A concentration plant for separating gold from manganese by an electromagnetic process is scheduled to be in full production by the end of 1962. About 2,000 meters of underground development has been completed by **Rhienstahl Industrie Planung GmbH** of Dusseldorf, Germany, in contract with the government.

Oceania

REPUBLIC OF THE PHILIPPINES—Production of gold by **Itogon-Suyoc** Mines totalled 4,145.33 ounces valued at Pesos 546,084.11 during September. Of this amount the **Itogon** mine accounted for 1,845.627 ounces from 10,464 tons of ore, while the **Suyoc** mine produced 2,299.703 ounces of gold from 9,437 tons. **Marsman & Company** manages the Itogon-Suyoc properties.

QUEENSLAND—A record 4,200 tons of blister copper were produced by **Mt. Isa Mines Ltd.** in the four weeks ending October 16 to top the previous high of 4,165 tons last April. Ore milled rose to a near record level of 7,900 tons a day in the latest period, compared with the record 8,214 tons a day for the 24-day period ended July 23. Total tonnage of all ore milled in the four weeks ending October 16 was 221,292 tons; output of lead bullion was 4,000 tons, zinc concentrate 4,471, and copper concentrate for shipment, 8,754 tons. Financially Mt. Isa Mines achieved its best record yet during the year ended June 30, with profits rising by 33 percent to pass the former record year of 1955-1956.

NEW ZEALAND—Manufacture of copper, a new industry for New Zealand, is to be undertaken under a joint arrangement by **Imperial Chemical Industries of Australia and New Zealand (ICIANZ)** and **Yorkshire Imperial Metals** of Leeds. The new venture will call for an investment of more than $5,600,000. The New Zealand government is supporting the project which includes manufacture of copper alloy sheet, strip and tube.

NORTHERN TERRITORY—Production figures for **Peko Mines N.L. Ltd.** at Tennant Creek show a marked increase for the fiscal year ended June 30. During the year three diamond drills have been kept in operation, geological and geophysical prospecting has been increased and more progress has been made in solving basic field problems. Tonnage of ore treated for the year was 138,917, compared to 117,569 last year; copper content of mill feed was 5.96 percent and gold content was 2.74 dwts. per ton, compared with 6.11 percent and 2.36 dwts last year. Proven ore reserves are now 698,000 tons, assaying 6.28 percent Cu, and indicated reserves 303,500 tons at 3.6 percent, for a total reserve tonnage of 1,002,300 which is slightly lower than the previous year's figure.

NEW SOUTH WALES—Preliminary assays of a recently discovered gold-bearing reef at Barrington Tops indicate a gold content of two to three ounces per ton. One of the discoverers, Sid Wright, said, in effect, that this may be the richest gold discovery in New South Wales. Several prospecting companies have shown interest and some preliminary ore crushings will be started in the next few weeks.

WESTERN AUSTRALIA — Development at the **Eclipse** gold mine at Mt. Magnet by **Eclipse Gold Mines N. L.** has revealed good values. Winzing and sublevel work below the 620-foot level has proved the extension of ore to a further depth of 76 feet on the extended shoot. Ore varying in value from 10.8 to 44.2 penny weights per ton has been encountered by this development.

Canada

BRITISH COLUMBIA—The Jersey lead-zinc mill near Salmo in southern British Columbia has been operating on a three-shift, five-day week basis and handling a little over 30,000 tons of ore monthly. The mine will be mined out in approximately two years at this rate unless new ore reserves are developed, according to the owner, **Canadian Exploration Ltd.**, a wholly-owned subsidiary of **Placer Development, Ltd.**

YUKON TERRITORY—A surface extraction program is under way this winter at the property of **Ketzakey Silver Mines Ltd.**, consisting of 44 claims located about 26 air miles south and east of Ross River. The main surface exposure on the Ketzakey mountain consists of massive high grade lead-silver over a measured width of 14 feet. High grade ore shoots increase the overall potential width to over 100 feet. Selected specimens have assayed over 500 ounces Ag and 35 percent Pb, while average assays of the high grade material are 80 ounces silver and 30 percent lead. A detailed exploration and development program is planned for the 1961 season, with completion of roads now being built. This winter the company plans to stockpile high grade material at the base camp for delivery to a smelter next spring.

BRITISH COLUMBIA—**Bralorne Pioneer Mines Ltd.** is converting its Bridge River district mill from a flotation to a cyanide treatment process. Bralorne has recently purchased from **New York Alaska Company** a one-third interest in the lead-zinc-silver property of **Jordan Mines Ltd.** located 15 miles northwest of Revelstoke. Independent surveying and surface sampling, conducted by the **Bunker Hill Company** of Kellogg, Idaho, on one of two sub-parallel orebodies on the property indicate reserves to be about 2,000,000 tons averaging 4.15 percent lead, 7.4 percent zinc, and 0.96 ounce silver per ton. **Consolidated Standard Mines,** which is managed by Bralorne, owns the other two-thirds of Jordan Mines.

Canadian Mining Institute Meets In Vancouver

Market potentials was the principal discussion theme when the Canadian Institute of Mining & Metallurgy held its annual Western meeting at Hotel Vancouver in Vancouver, British Columbia, October 17-19. According to marketing authorities who addressed the 500 delegates, Japan is seen as the major importer of metals from that province. British Columbia mines are now shipping large amounts of iron ore and copper to Japanese mills and smelters and recently revised provincial legislation encourages this movement.

Among speakers at the meeting was H. Minagawa, Canadian representative of Mitsubishi Shoji Kaisha Ltd., who predicts appreciable expansion of Canadian exports to Japan during the next ten years. The increased exports will include potash, asbestos and gypsum as well as iron, copper and coking coal. According to Emmet A. Torney, general sales manager of The Bunker Hill Company, San Francisco, chances of increasing Canadian exports of lead and zinc to the United States are slight, since the market for both metals in that country has been severely hit by substitute products.

Allan F. Lowell of the marketing department of Rio Tinto Mining Company Ltd., Toronto, predicted a gradual increase in the European market for Western Canada's metals and recommended a greater degree of processing in Canada rather than export of raw ore and metals treated only in primary phases.

Pictured here in a discussion of the program are (left to right): Dr. J. Sproule of Calgary, past president, CIM; R. B. King, chairman, B. C. section; Carlyle Gerow, secretary-treasurer, CIM, and H. A. McDiarmid, president, B. C. division, Canadian Manufacturers Association. Mr. McDiarmid was one of the principal speakers at the meeting.

Members who worked with Mr. King, general chairman, in arranging the convention included William Pryde who was chairman of the technical program; J. H. Lee; R. C. MacDonald; D. M. Gallup, E. J. Burchell, J. W. Hay, F. G. Pearce, Dr. K. C. McTaggart, W. J. Weymark; A. O. Wolff, L. G. R. Crpich; D. M. Cannon, J. E. McMynn, J. F. Melton, and J. E. Merrett.

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Europe

SWEDEN—**LKAB** has completed its new compressor plant in Kiruna and has begun its expansion program to raise production from 12,000,000 to 15,000,000 tons a year. The Atlas-Copco compressors at the new plant consist of three two-stage screw units that deliver 450 cubic meters and four piston compressors delivering 90 cubic meters per minute. The cooling system permits use of the cooling water in the central heating system at the crew's changing room and the hot water is used for washing. Radiant heat from the motors and compressors is blown underground to heat part of the mine.

SICILY—The **Montecatini Company's San Cataldo** potash mine and Campofranco processing plant began operations late in October. The completely mechanized mine has an output of 3,000 tons of kainite per day and is connected by a 12-mile cableway to the plant, which has a yearly capacity of more than 200,000 tons of potash sulphate and other potash salts. Some of the Campofranco output goes to Montecatini's Porto Empedocle fertilizer plant.

UNITED KINGDOM—In the last fiscal year **Geevor Tin Mines Ltd.** of Cornwall completed 7,269 feet of development on six lodes, with results less favorable than those of the previous year. A diamond drilling program to discover other payable lodes has been started. Some 65,662 tons of ore were milled, compared with 63,484 in the previous year; the grade of ore fell from 24.1 to 22.12 pounds of recoverable black tin (65 percent metal) per ton. Although tin prices were higher, this was offset by the lower output, higher production costs, and decreased revenue from sale of flotation residue for its copper content. Actual operating costs at the mine fell by almost one shilling a ton. Recent studies show that the sea has entered the underseas workings of the adjacent **Levant** mine. Geevor has underseas lease rights to the Levant. The company reports milling improvements in the use of cyclones for removal of colloidal slimes and recovery of ultra-fine cassiterite.

YUGOSLAVIA—Bauxite exports totalling nearly 1,000,000 tons are expected this year, an increase of some 40 percent from previous years. Main sources of bauxite are the mines of **Niksic, Drnis, Rovinz,** and the mines in Mostar. Several smaller producers on the Adriatic Coast and in Bosnia are adding to the output. About 500,000 tons of bauxite are shipped by sea; the remainder goes by rail to various Danube River ports for reshipment. Major purchasers are East and West Germany, Czechoslovakia, Italy, Austria, and Great Britain.

SPAIN—The Spanish Cabinet has allocated another 13,000,000 pesetas for drainage work in the **Linares** mining basin, where the drainage tunnel intersected some promising lead veins earlier this year.

EIRE—At the **Mountain** mine of **Can-Erin Mines Ltd.** in County Cork, work has been concentrated on diamond drilling from the 1,350-foot level (1,510-foot horizon) and cross-cutting to the north for diamond drill stations at the east end of the drift on the 800-foot level, where only 50 feet of crosscutting remain to be completed. After that it will be possible to start the diamond drill program to prove the block of ore in the East-West ore body which is estimated to contain over 1,000,000 tons between the 400 and 1,350-foot levels. During the past three years the company has unwatered the mine down to the 1,350-foot level, the bottom of the old pumping shaft, and retimbered the original incline to this depth.

SPAIN—Continued expansion and modernization mark the Spanish iron and steel industry where 1959 production increased 15 percent over that in 1958. **Altos-Hornos-Basconia** will expand its steel mill facilities with the aid of a recently approved $5,500,000 loan from the Export-Import Bank. The loan will be used for purchase of United States equipment for a new electrolytic tinning line and a cold rolling stand at the Echevarri works. The project will permit an increase in tin plate production to 100,000 tons per year. Another firm, **Ensidesa,** which began operations only two years ago, continues to expand with current plans for installing six new double-burner ditch furnaces. While domestic requirements for iron and steel in Spain are still below par, foreign demands have intensified. Alto Hornos-Basconia reports much of its output is already sold, while Ensidesa's pig-iron production until next January is committed and no orders are being taken at present. A similar situation has arisen in the supply and demand for billets. Part of the favorable competitive position of Spanish iron and steel is attributable to the low price of Spanish iron ore, however current costs represent 92.44 percent of the gross product, so it is important for the modernization programs to continue.

YUGOSLAVIA—Deposits of high quality bauxite have been located in Central Bosnia, near Jacje, in Cemernica, Surjani, Liskovica, Poliane and Bespelj. Those at Bespelj, already under development, are said to be of very high grade, with reserves estimated at 1,500,000 metric tons. The rock formation in this region is of Triassic and Jurassic ages, which is rather unusual for the country. Average content in the ore is 58 percent Al_2O_3 with silica less than 2.0 percent. Loss from heating is only about 12 percent. The Bespelj mine is fairly close to the Bosnian railway and ore is presently delivered to the Kidricevo works.

UNITED KINGDOM—Large deposits of salt, estimated at 400,000,000,000 tons, have been discovered in Cheshire and North Shropshire by the **Geological Survey of Great Britain** during an 800-square mile survey of the area, including the Cheshire salt field. Up to now, the Cheshire salt industry has been thought to draw its brine from one group of beds about 600 to 800 feet thick. However, the Department of Scientific and Industrial Research says it is now clear, after deep drilling operations, that there are two salt-bearing groups. The lower one is that developed in the neighborhood of Northwich and Winsford, while the brine pumped in the Sandbach and Middlewich area appears to belong to the upper group. The lower group extends beneath a 400-square mile area and the upper group beneath about 170 square miles of the Cheshire basin. In each case, there is a further undefined extension southwards.

Israeli Copper Estimates Double Former Tonnage

Estimates of proven copper reserves in the Timma region of Israel have been doubled, with tonnage now put at about 17,000,000 tons. Average copper content of the ore in the Southern Negev deposits is 1.4 percent.

New discoveries made last spring by geologists of the Israeli Geological Survey in the Timna vicinity, plus a reappraisal of already known deposits in the area, resulted in the revised estimates. The geologists reported encouraging discoveries, but are awaiting the outcome of several diamond drill test holes.

Israel Mining Industries plans to raise output of its presently operating Timna mines to about 1,200,000 tons yearly. The copper precipitation plant at Timna began operating in 1958, reaching full capacity last year. The company now exports cement copper for refining into electrolytic copper, but is making plans for refining it at the Timna plant.

Asia

THAILAND—The new sea dredge operated by **Tongkah Harbour Tin Dredging Ltd.** on off-shore leases six miles from Bhuket Island has made an average tin recovery this year of 1.56 pounds per cubic yard. A record was set in June when production climbed to 157.98 tons of concentrate. The sea leases off the west coast of Thailand cover 2,370 acres.

ISRAEL—Production of electrolytic copper during the first full year of operation for the **Timna** copper plant is expected to reach 5,400 tons, about equal to 90 percent of the plant's planned annual capacity. Improvements in the plant are expected to raise the rate to 6,500 or 7,000 tons per year.

IRAN—**Societe General des Minerais of Belgium** has sent representatives to investigate mining possibilities in Iran. The preliminary study will probably be followed by a geological study of interesting areas.

JAPAN—Negotiations under way by **The Yawata Iron & Steel Company** and the **Fuji Iron & Steel Company** concern a sizeable long-term contract for importing iron ore from Swaziland. The discussions with the **Anglo-American Corporation of South Africa** call for importing 10,000,000 tons of ore over a 10-year period to start in 1963. The ore is reportedly of high grade, ranging from 62 to 65 percent (See MINING WORLD, November 1960, page 69.)

MALAYA—The Perak State Government reportedly has agreed in principle that 14 acres of land where the small town of Lahat is located should be released for tin mining. Preliminary surveys indicate that the tin content of the area is about 1,000 tons. **New Lahat Mines Ltd.**, a Chinese syndicate now operating a tin mine near Lahat, has made application to mine the released area.

INDIA—**India Hard Metals (Private) Ltd.** of Calcutta, in collaboration with **Wickman Ltd.** of England, is establishing a factory to produce tungsten carbide powder, tips, and tools. Orders for the entire plant and equipment have

been placed. The first phase of the project is expected to commence before the end of the year.

JAPAN—Greater dependence on foreign ore for its domestic needs has been revealed by a survey of the Ministry of International Trade and Industry which compares actual 1959 import figures with those estimated for 1960. The report discloses that imports of graphite, asbestos, and manganese ore this year will show a decrease, but those of copper, lead, iron, mercury, tungsten, antimony and gypsum will show increases. A comparison of domestic production and estimated imports for 1960 and for 1959 (shown in parentheses) is as follows: Copper—domestic, 90,000 metric tons, 130,000 tons (87,059 and 89,077); lead—38,300 and 49,290 tons (37,499 and 22,947); manganese—337,000 and 211,000 (317,000 and 223,000); mercury—243 and 773 tons (215 and 505); tungsten—900 and 3,150 (880 and 1,220); molybdenum—820 and 2,855 (795 and 2,354), and antimony—315 and 3,015 (315 and 2,430).

INDIA—Recent drilling and survey operations undertaken by the Government of India indicate greater reserves of uranium ore than previously estimated. High grade uranium ore lenses have been located in Umra in the Udaipur district, while surveys of the sea bed off Chavara coast in Kerala indicated a high radioactivity zone extending some 10 miles. The **Jaduguda** mines in Behar state have produced more than 2,500 tons of ore. The government is currently importing some 26,500 kilgrams of uranium for experiments in making fuel elements at the Trombay factory in Bombay.

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1—3' x 8' Morse New Rod Mill
1—5' x 10' Denver Ball Mill

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8 Ton Plymouth Locomotive

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42" Traylor Gyratory Primary Crusher
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5½' Symons Std. Cone Crusher
7' Symons Snort Head Cone Crusher
10—No. 6s Wilfley Concentrating Tables
78"x36' 6" Akins Duplex Spiral Classifier
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